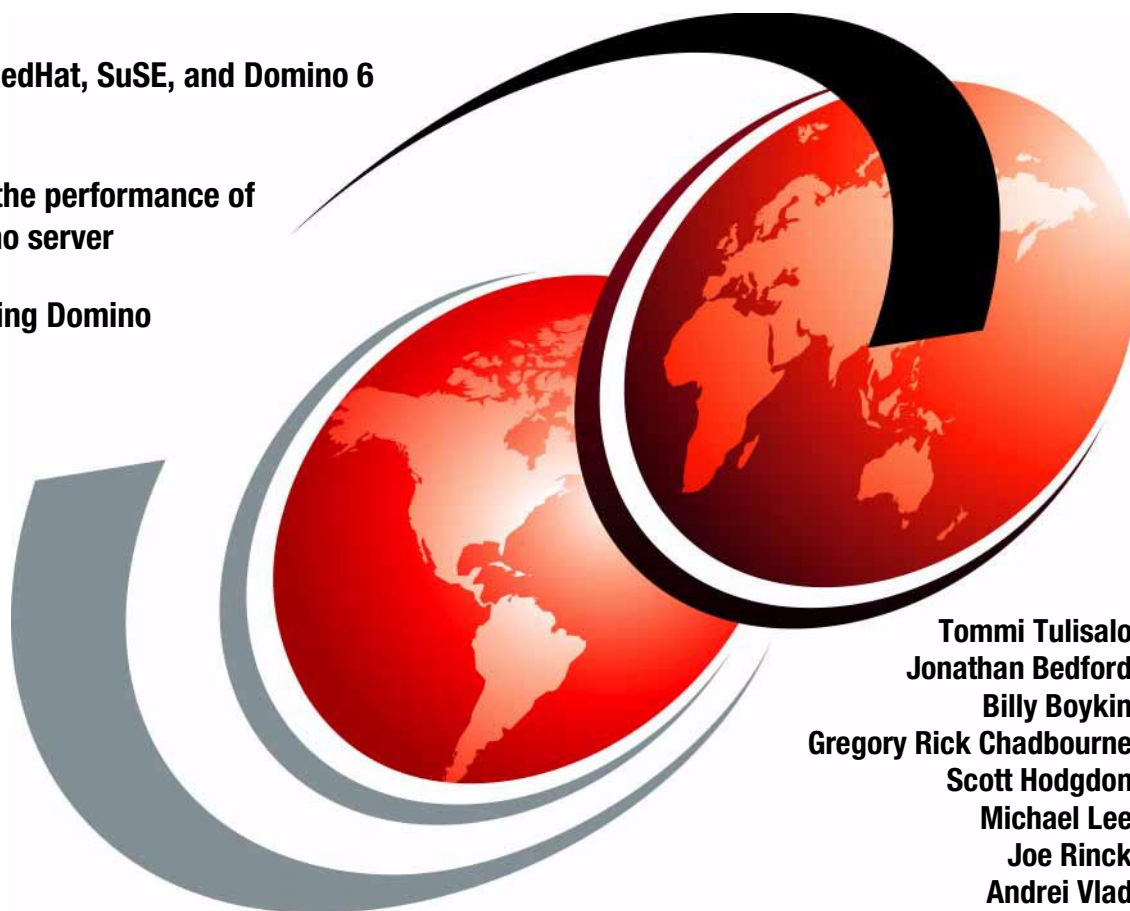


# Lotus Domino 6 for Linux

Installing RedHat, SuSE, and Domino 6  
for Linux

Improving the performance of  
your Domino server

Administering Domino  
and Linux



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International Technical Support Organization

**Lotus Domino 6 for Linux**

November 2002

**Take Note!** Before using this information and the product it supports, be sure to read the general information in “Notices” on page vii.

### **First Edition (November 2002)**

This edition applies to Lotus Domino Server Pre-Release 2 for Linux, RedHat Linux operating system 7.2 and SuSE Linux operating sytem 8.0.

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# Preface

This IBM Redbook describes how to run the IBM Lotus Domino 6 server on the Linux platform. While Lotus Domino 6 is platform-independent, some specific knowledge about the platform and configuration is required to ensure that the Domino 6 server is running most efficiently.

The book provides detailed instructions for installing Linux and Domino 6 for Linux, and describes how to achieve maximum performance of your system. System administration and security techniques are explained and tools for managing and troubleshooting are discussed as well.

Detailed scenarios illustrate some of the features of Domino 6 on Linux, in particular user registration, directory synchronization, creating a Domino application, and accessing external data using DB2 and MySQL. We describe how to configure Domino as a Web server, including the new security options specific to the HTTP protocol in Domino 6. Strategies and techniques for virus protection and data backups are presented, along with details about some of the third-party software packages available to help you with these management tasks.

This redbook is written for administrators with strong Domino and Windows operating system skills, but who are not experts on Linux. Therefore, we show in detail how to install and configure a Linux operating system on your server, but don't spend too much time explaining basic Domino features. Instead, we focus on demonstrating that Linux is an excellent platform on which to run Domino 6.

## The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, Cambridge Center.

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A number of people have provided support and guidance. In particular we would like to thank **Greg Kelleher**, Lotus Linux Product Manager, for all the help and support he gave to the team.

Thanks to **Telford Knox** and **Brian Twitchell** from the IBM Austin System Performance team and **Andrew Nolet** from the IBM Westford Performance team for sharing their experiences and results about Domino for Linux performance tuning.

Two IBM Redbooks have been of special help and we have adapted some of the contents of them: *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968 and *Lotus Domino R5 for Sun Solaris 8*, SG24-5909. We would like to thank the authors of those books.

Thanks to the following people for their contributions to this project:

Kevin Baringer, Eddy Bell, Ken Brunsen, Thomas Gumz, Mallareddy Karra, Shane Kilmon, John Woods - IBM Westford Lab

George Brichacek, John Dore, John Goegel, Vicki Laine, Ted Niblett, Susan Taipalus, Chris Wilkes - Lotus software

Jacob Carstensen, IBM

Anthony Barker, XM Technologies

Bruce Beadle, David Kerr, Doc Shankar, IBM Linux Integration Center

Red Fisher, Symantec

Rolf Rennemo, Cathy Reed Weber, Trend Micro

Heiko Brenn, GROUP Technologies AG

Michael Robinson, Innovative computer solutions

William Tworek, ITSO Cambridge

Alison Chandler, ITSO Poughkeepsie

## Notice

This publication is intended to help Domino and network administrators install, configure and run Lotus Domino 6 on the Linux platform. The information in this publication is not intended as the specification of any programming interfaces that are provided by Domino. See the PUBLICATIONS section of the IBM Programming Announcement for Domino for more information about what publications are considered to be product documentation.

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# Installing Linux

In this chapter we describe how to install Red Hat and SuSE Linux on your server. The chapter is divided into two parts, with each part giving detailed instructions for the particular distribution of Linux.

## 1.1 Before you begin

Read the following section before performing the installation of Linux. There are several things you need to do or should be aware of to make the installation process easier. In addition, make note of the following information about your system, which will be useful when you perform the installation:

- ▶ Network card type
- ▶ Network information
  - IP address
  - Gateway information
  - DNS servers
- ▶ Video card type
- ▶ Number and types of hard drives
- ▶ Monitor information

### 1.1.1 Making the CD-ROM/DVD drive bootable

The recommended way of installing Linux is to boot from the installation CD-ROM. If you plan to boot your system directly from the CD-ROM, ensure that the CD-ROM is the initial boot device. Do this by following these steps:

1. Power on your server.
2. Enter the BIOS setup utility.
3. Make sure that your CD-ROM is the initial boot device.
4. Save the settings.
5. Exit the setup utility.

The alternative is to make boot diskettes from the Distribution CDs and use those to boot the system. Do this by following these steps for Red Hat:

1. Insert Red Hat Installation CD 1 into a Windows machine.
2. Use RAWRITE from the DOSUTILS directory to write the disk image to a Floppy disk. The disk images are stored in the IMAGES directory on the Red Hat Install CD. The files in this directory are raw disk images. Some are boot disks for booting the Red Hat Linux installation program. Others are driver disks supporting less common hardware. Follow the instructions in the Red Hat Linux Installation Guide to create the disks.

For an example of this command, see “RAWRITE utility” on page 3.

Follow these steps to create the boot disks for SuSE:

1. Insert SuSE Installation CD 1 into a Windows machine.
2. Use RAWRITE from the DOSUTILS\RAWRITE directory to write the disk image to a Floppy disk. The disk images are stored in the DISKS directory on the SuSE Install CD. The files in this directory are raw disk images. The following files are boot images: bootdisk, i386, and rescue. Only a few modules fit on the boot disk. Therefore, three modules floppy disks exist. You will need these diskettes if you cannot find the driver for your hardware on the normal disk. The modules disks contain the following files:
  - Modules1: USB and file system modules
  - Modules2: SCSI/RAID/IDE modules and old (non-ATAPI) CD-ROM drivers
  - Modules3: Network, PCMCIA and FireWire (IEEE1394) modules

### ***RAWRITE utility***

RAWRITE is a utility usually shipped with the Linux distribution; it is used to write the prepared diskette images to diskettes, enabling them to be used in the installation process.

To create a diskette from one of these prepared images use the following steps.

1. Load the Linux CD on a Windows machine.
2. Open an MS-DOS prompt.
3. Change the default directory to the directory where the diskette images are stored (this varies according to the distribution of Linux used).
4. Run the following command by pre-pending the directory where the RAWRITE program is stored.

```
\path\rawrite image a:
```

For Red Hat, replace x with your CD-ROM driver letter and run:

```
x:
cd \images
\dosutils\rawrite -f boot.img -d a
```

For SuSE, replace x with your CD-ROM driver letter and run:

```
x:
cd \disks
\dosutils\rawrite\rawrite
bootdisk
a
```

There is a version of RawWrite for Windows. This is available from:

<http://uranus.it.swin.edu.au/~jn/linux>

## 1.1.2 RAID configuration

If you have a machine with a RAID controller, you need to configure the disks before you install Linux. Use the same procedure to configure your RAID sets as you would for a Windows NT or Windows 2000 machine. Once your RAID is configured, and the logical disk is online, you can proceed with the installation of Linux. You may need a driver disk for the Linux installation.

## 1.1.3 Partitions

We have simplified the typical UNIX partitioning scheme. A conventional UNIX-style install would include partitions for /home, /usr, and more. However, a Domino server does not require or use a number of these partitions, so they are simply a waste of disk space. Therefore, we have concentrated on the ones important for Domino.

**Attention:** One reason for a conventional UNIX-style install is to prevent users of your system from filling your hard drive. Therefore, if you are installing Linux on an external system that will have exposed volumes, such as an FTP area, you should create a partition specifically to hold the FTP data. While this will limit the total amount of available disk space, it will keep your system from crashing should someone intentionally or unintentionally use all remaining disk space.

*Table 1-1 An example of partitioning on a Domino Server*

Partition	Description	Minimum Size	Recommended Size
/	Root partition	2 GB	3 - 9 GB
/local	Partition for data		See Note 1
/translogs	For Transaction logs		See Note 2
/var	For system files, such as log files	256 MB	512 MB
<swap>	Page File		See Note 3

Table notes:

1. This is where your Notes Data is stored. Depending on the number of users and amount of data you keep, this partition can require a lot of disk space.
2. This partition is needed if you will be using Domino Transaction Logs. We recommend that you do so and that you dedicate a 4 gigabytes RAID1 to the transaction logs. You may skip creating this partition if you are not going to

make use of transaction logs. See “Transaction logging” on page 229 for more information.

3. See Table 1-2 for recommended SWAP partition sizes.

*Table 1-2 SWAP Memory size*

Amount of physical memory	Size of SWAP partition
< 256Mb	4 times physical memory
512Mb	2 times physical memory
1024Mb	1 times physical memory
2048Mb >	2048Mb

### 1.1.4 Time configuration

During the Linux installation process, you will be asked if your system clock is set to UTC (Coordinated Universal Time) or to local time. We recommend that you set the system clock (the BIOS clock) to UTC/GMT. This way Linux can keep the clock on the correct time when the change for Daylight Saving Time occurs. The safest way is to set your clock to UTC before beginning the installation process. Should you have missed this, you can still set the system clock immediately after you have completed the installation and before the first time your machine reboots.

Coordinated Universal Time is the international time standard. It is the current term for what was commonly referred to as Greenwich Meridian Time (GMT). Zero hours UTC is midnight in Greenwich, England, which lies on the zero longitudinal meridian. Universal time is based on a 24 hour clock; therefore, afternoon hours such as 4 pm UTC are expressed as 16:00 UTC.

### 1.1.5 Video card and monitor

It is not as easy to configure your monitor and video card in Linux as it is in Windows. If you currently have Windows installed on the machine that you are going to use for Linux, check the video card and monitor and their respective settings before starting the Linux Installation. This will help you later in the install process to select the right settings. You could also open the machine and check which video card is installed.

### 1.1.6 File systems in Linux

Linux supports multiple file system types. Examples of file systems in Windows are FAT, FAT32, and NTFS. As new or better file systems are developed, they are

incorporated into the kernel. In Linux, as in other UNIX derivatives, the separate file systems that are available for use by the system are combined into a single hierarchical tree structure rather than being addressed by drive names. Each new file system is added into this single tree structure by mounting the file system onto a specified directory. This directory is known as the mount point. The files and directories in the mounted directory are then accessible through this directory. If a file system is mounted onto a directory which already contains files, these files are masked by the new file system and so are unavailable. Once the file system covering them up is unmounted, the files become visible again.

Initially, Linux used the *minix* file system. This had restrictions and performance problems, which were solved in April 1992 by the introduction of the *Extended File System* (ext). The ext file system was developed as an expandable and powerful file system for Linux. In January 1993, the *Second Extended File System* (ext2) was released. It has become the most successful file system for Linux and is the standard file system for most Linux distributions. While being a very solid, stable file system with good performance, it is quite slow to run a file system check (similar to CHKDSK). This occurs when the system fails and is being brought back up, or every twentieth time the file system is mounted. On a system with big partitions, this check can take a while, and the system is inaccessible during the check.

To solve these problems, new journaled file systems were introduced with the 2.4 Linux kernel; we briefly discuss them in the following paragraphs.

Journaling ensures consistency of the file system. This means that you do not have to run the file system check if the system should go down unexpectedly. In order to minimize file system inconsistencies and restart time, journaling file systems keep track of changes that they are about to make to the file system. These records are stored in a separate area of the file system, which is known as the journal or log. Once the journal records have been successfully written, the changes to the file system will be applied and the journal entries purged. If the system should go down unexpectedly, this process ensures that the file system is consistent without the need for a lengthy check.

1. ext3 - ext3 extends the ext2 file system by adding journaling. This means that it shares ext2's robustness and performance. One major advantage of ext3 compared to other journaled file systems is that it is forward and backward compatible with ext2. You may freely switch between ext2 and ext3 as long as the file system has been cleanly unmounted or a file system check has been run.
2. ReiserFS - ReiserFS stores not just the file names, but also the files in a balanced tree. Balanced trees have a sophisticated algorithmic foundation and are more robust in their performance. Storing small files in large partitions is very efficient. Being more efficient at small files, however, does not mean it



is inefficient at storing larger files. ReiserFS is considered a truly multipurpose file system.

We have opted to use the ext3 file system for the Linux servers used in writing this book.

**Note:** The ext2 is a faster filesystem due to the fact it is not journaling everything, but it takes a lot longer to recover from a system failure than a journaling filesystem.

An excellent source of information about file systems is the File Systems HOW-TO. You can find this HOW-TO document, as well as numerous others, on The Linux Documentation Project Web site at:

<http://tldp.org/docs>

Additional information about the ext3 file system can be found on:

<http://www.redhat.com/support/wpapers/redhat/ext3>

<http://www.linuxplanet.com/linuxplanet/reports/4136/1/>

The home page for ReiserFS is located at:

<http://www.reiserfs.org>

## 1.1.7 Different Linux distributions

Domino 6 for Linux supports two different Linux distributions, identified in Table 1-3.

*Table 1-3 Supported Linux distributions*

Distributions	Kernel version	Home page
Red Hat 7.2 or newer or Red Hat Advanced Server 2.1	2.4.18	<a href="http://www.redhat.com">www.redhat.com</a>
SuSE 8.0 or newer or SuSE Groupware Server 7 with Lotus Domino	2.4.18	<a href="http://www.suse.com">www.suse.com</a>

**Note:** We recommend using the enterprise/groupware versions of the Red Hat or SuSE Linux instead of the personal or professional version. The enterprise/groupware versions have an extended release cycle. The enterprise server versions have also been certified by the top ISVs, such as IBM.

## UnitedLinux

In May 2002, four companies, Caldera, Conectiva, SuSE, and Turbolinux, announced that they had formed a consortium to develop a single distribution of the Linux operating system. This distribution is called UnitedLinux. Previously, each of these companies had their own Linux distributions.

By developing a unified distribution, UnitedLinux is attempting to help Linux vendors, ISVs, and OEMs to support a single Linux offering, instead of many different versions. By combining their skills and resources, the four companies are trying to make a better, standards-based business version of the Linux operating system.

The consortium has announced that a public beta of UnitedLinux will be available in Q3'2002 and the first release version will still be available in Q4'2002.

IBM plans to add support for UnitedLinux to Domino 6 for Linux, once UnitedLinux version 1 has been released.

## 1.2 Installing Red Hat 7.2

In this section we show you how to install Red Hat 7.2 Professional on your server.

**Note:** At the time of writing, 7.2 was the newest version of the Red Hat Linux and it was used to create the installation instructions. Version 7.3 of the Red Hat Linux operating system was released later in May 2002. The redbook team did some limited testing with version 7.3, and all the installation instructions seemed to apply also to this version.

**Note:** We recommend using Red Hat Advanced Server version 2.1 or newer instead of the RH Personal or RH Professional version. The RH Advanced Server version has an extended release cycle. The RH Advanced Server has also been certified by the top ISVs, such as IBM. The installation of the RH Advanced Server is similar to the installation of the RH Professional version, which we detail here.

To capture the screens shown in this book, we have installed and configured Linux in a VMware window. VMware is a product by VMware, Inc. (<http://www.vmware.com>). It allows you to run one operating system as a guest of another. This means that some of the screens might look slightly different from what you would see on your system. These differences are hardware-related, as VMware emulates different hardware devices for the guest operating system.

Be sure to read “Before you begin” on page 2 to make the installation easier. To start the installation, insert the Red Hat 7.2 CD-ROM and turn on or reboot the server.

**Attention:** The installation process will destroy any existing data stored on your hard disk drives.

```

Welcome to Red Hat Linux 7.2!

- To install or upgrade Red Hat Linux in graphical mode,
  press the <ENTER> key.

- To install or upgrade Red Hat Linux in text mode, type: text <ENTER>.

- To enable low resolution mode, type: lowres <ENTER>.
  Press <F2> for more information about low resolution mode.

- To disable framebuffer mode, type: nofb <ENTER>.
  Press <F2> for more information about disabling framebuffer mode.

- To enable expert mode, type: expert <ENTER>.
  Press <F3> for more information about expert mode.

- To enable rescue mode, type: linux rescue <ENTER>.
  Press <F5> for more information about rescue mode.

- If you have a driver disk, type: linux dd <ENTER>.

- Use the function keys listed below for more information.

[F1-Main] [F2-General] [F3-Expert] [F4-Kernel] [F5-Rescue]
boot: _
```

Figure 1-1 Red Hat 7.2: Initial boot screen

1. Once the screen shown in Figure 1-1 is displayed, you are ready to start the Linux installation. Press Enter to begin installation immediately or wait for it to start automatically after a short pause.
2. The system will begin to probe (detect) the hardware installed on your system and load the appropriate drivers for it. The Welcome to Red Hat Linux window is displayed while this is happening.

Once the drivers are loaded, the Red Hat Install Program will start. We used the graphical setup program, so this is what is described here. If the graphical installation fails to start, consult your *RedHat Installation Guide*.

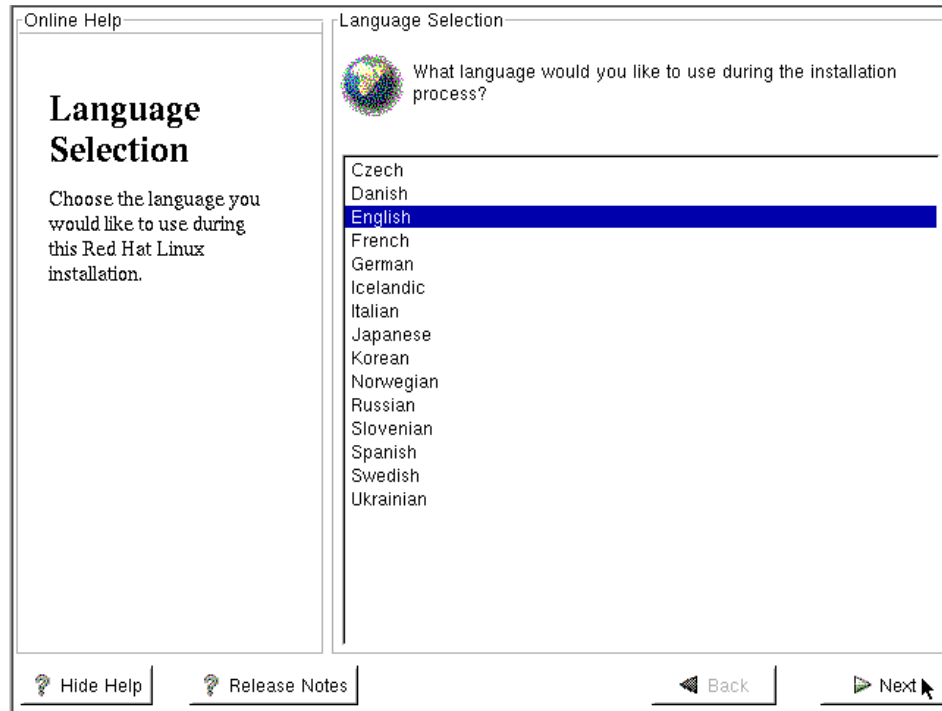


Figure 1-2 Red Hat 7.2: Language selection

3. Select the language from the list shown in Figure 1-2 that you would like to use *during the installation*. You will be prompted later for the languages the OS should support. Click **Next** to continue.

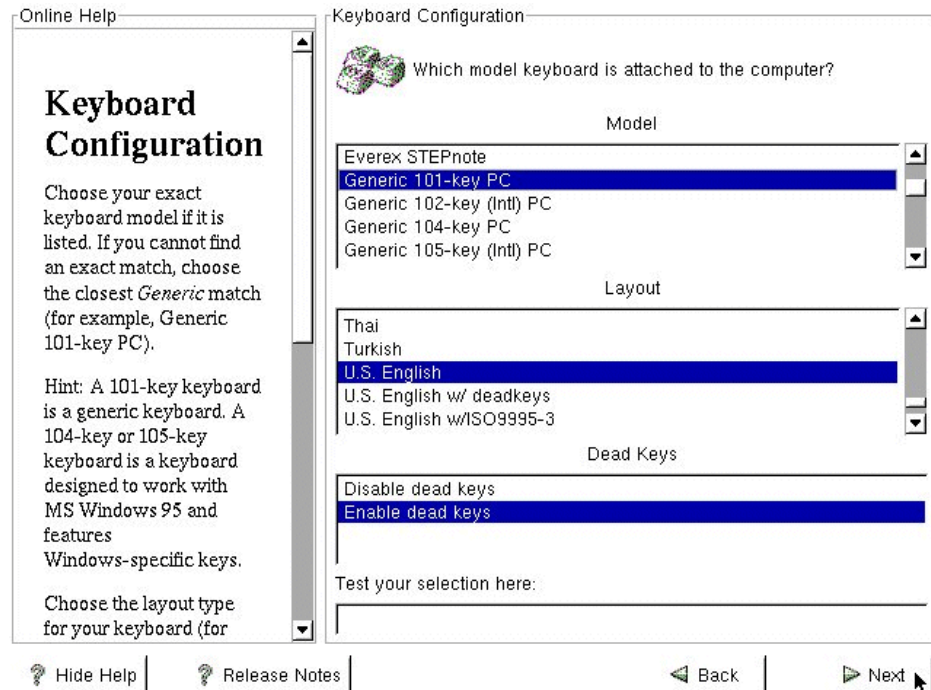


Figure 1-3 Red Hat 7.2: Keyboard configuration

4. The Keyboard Configuration screen is shown in Figure 1-3. Specify the keyboard attached to your computer. If in doubt, select Generic 101-key. Click **Next** to continue.

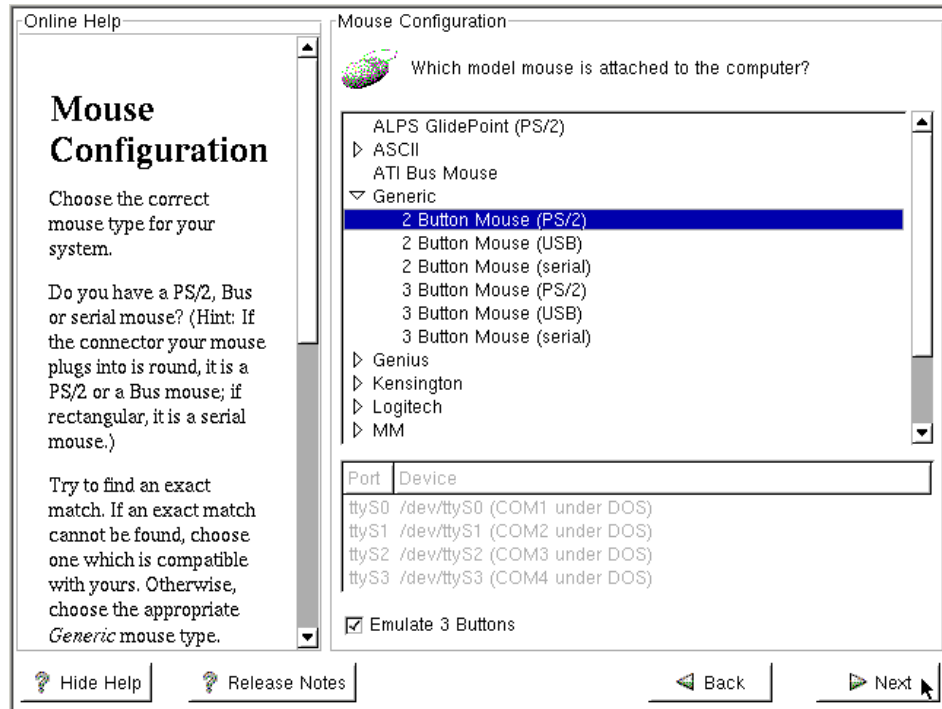


Figure 1-4 Red Hat 7.2 - Mouse Configuration

- As shown in Figure 1-4, you can select different mouse settings. Specify the type of mouse attached to your system and click **Next**.

Most systems have two button PS/2 mice so you should make certain to check the emulate 3 button mouse.



Figure 1-5 Red Hat 7.2: Welcome

**Tip:** If you do not need the Online Help bar on the left-hand side of the screen, you can disable it by clicking the **Hide Help** button in the bottom left corner of your screen. To see the help again, click the **Show Help** button.

6. On the welcome screen shown in Figure 1-5, click **Next** to start the Red Hat System Installer. The Install Options screen shown in Figure 1-6 will be displayed.

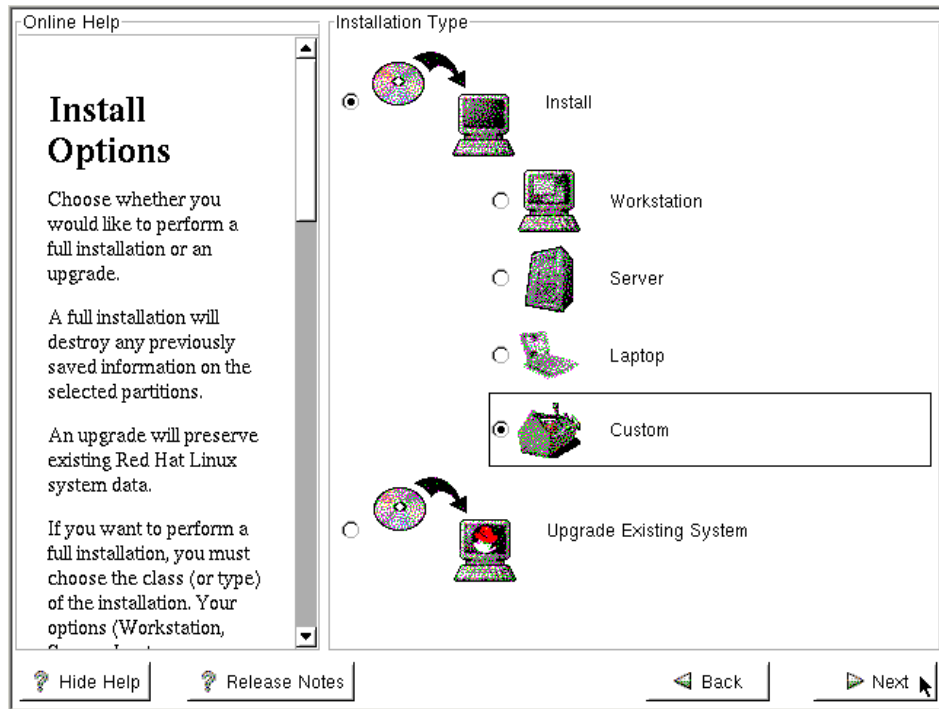


Figure 1-6 Red Hat 7.2: Install options

7. On the Install Options screen, select **Custom** and click **Next**.

**Note:** Some disk controllers require drivers supplied by the manufacturer and are not supported out of the box. See <http://www.redhat.com/docs/manuals/linux/RHL-7.2-Manual/install-guide/ch-driverdisk.html> for more information about installing disk drivers.



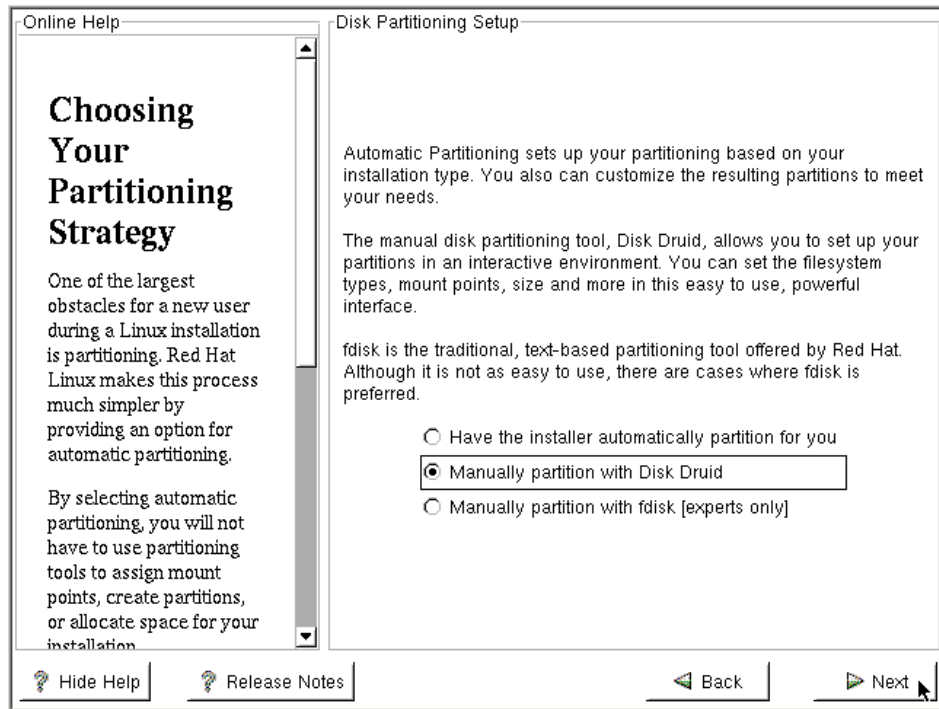


Figure 1-7 Red Hat 7.2 - Partitioning

8. On the following screen, shown in Figure 1-7, select the method you would like to use to partition your hard disk(s). We selected “Manually partition with Disk Druid” to partition the disk because the automatic process will not provide an optimal partitioning scheme. Click **Next** to continue.

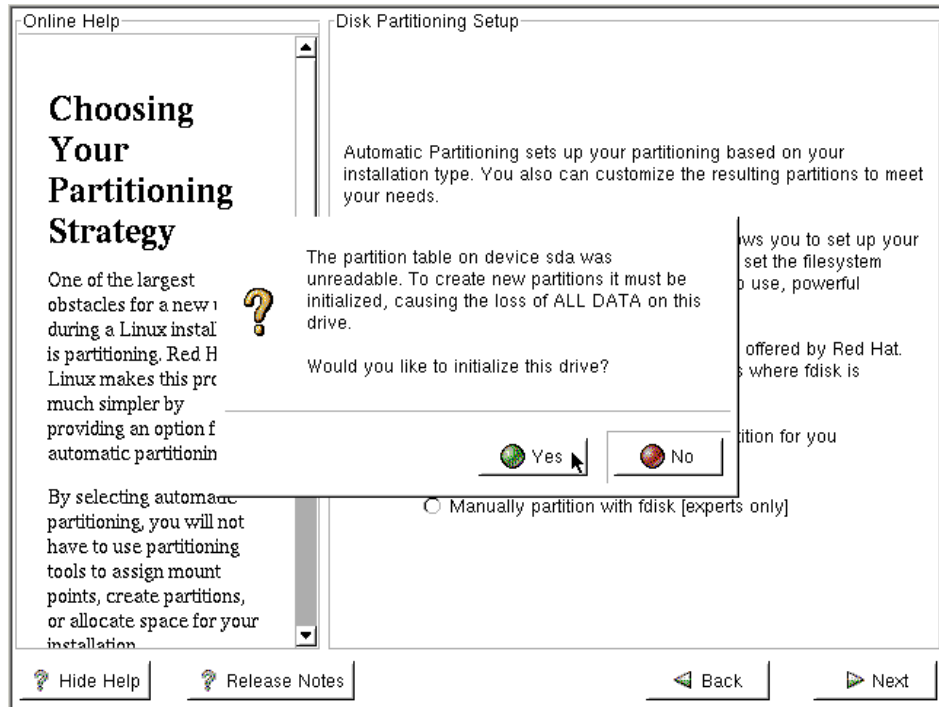


Figure 1-8 Red Hat 7.2: Unreadable partition table notice

9. You may see a message indicating that the partition table is unreadable, as shown in Figure 1-8. This usually happens when you have new, unformatted disks. Click **Yes** to initialize each of the drives installed in your system. This message will not always appear.

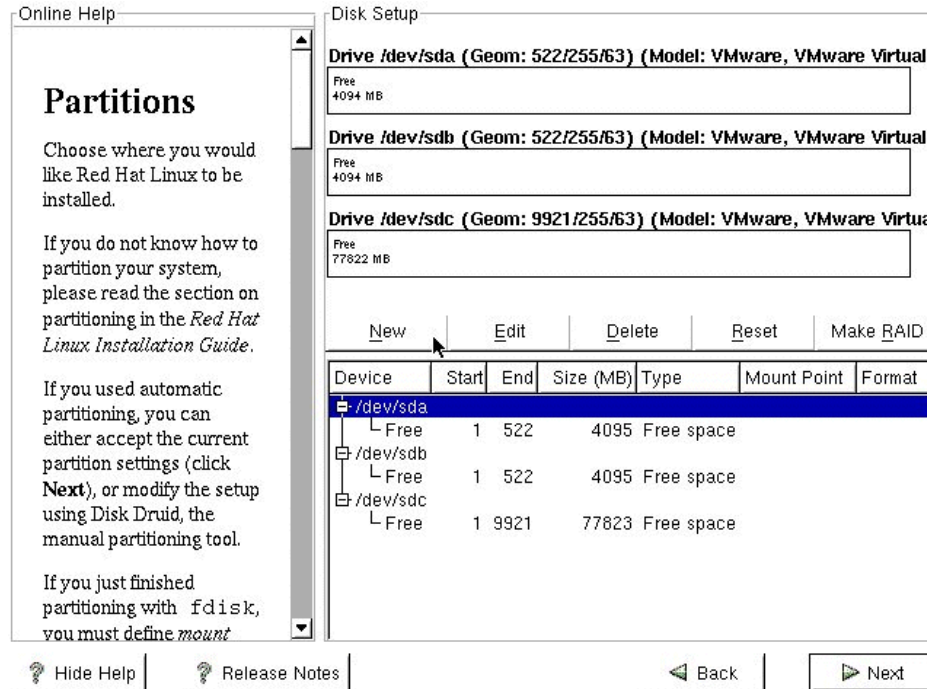


Figure 1-9 Red Hat 7.2: Drive geometry

10. We are now ready to partition our disks. Have a look at section 1.1.3, “Partitions” on page 4 for the recommended partitions and their respective sizes. You might also want to review “Linux performance” on page 196 for alternate configurations using software RAID and Logical Volume Manager (LVM).

**Important:** If you have existing partitions from another operating system on your machine, you must delete them before you can create the Linux partitions. Once the old partitions are deleted, proceed with the next step.

11. As shown in Figure 1-9, click **New** to create your partitions.

**Important:** You can only have four primary partitions for each hard disk drive. If you need to create more than four partitions, create three *primary* partitions and one *extended* partition that uses all the remaining disk space. You can then create all subsequent partitions in this extended partition.

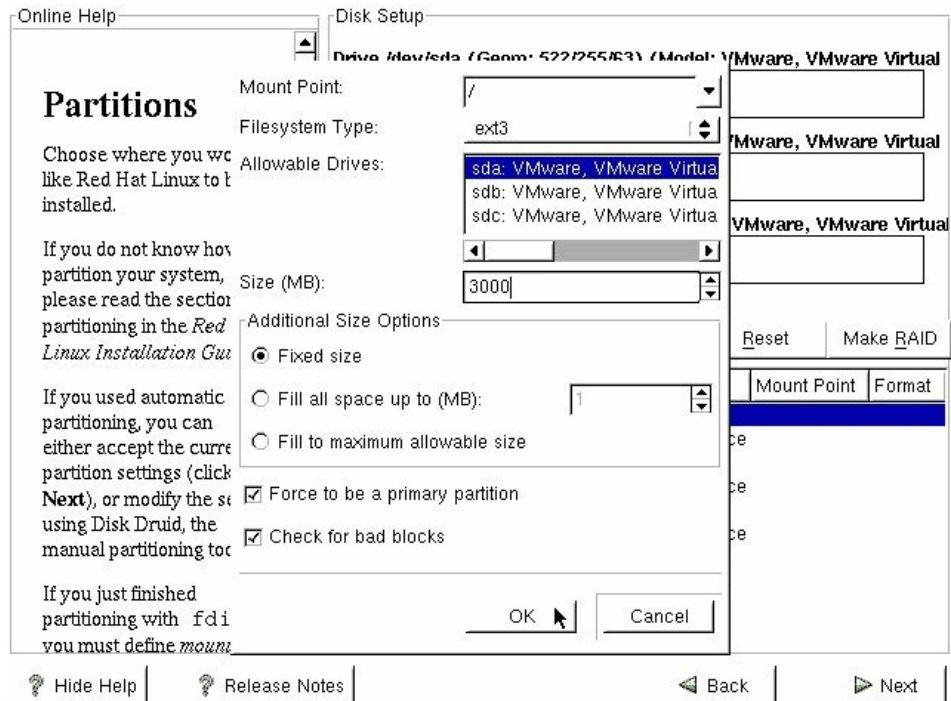


Figure 1-10 Red Hat 7.2: Creation of the / (root) partition

12. A window will be displayed, as shown in Figure 1-10, to allow you to enter all the relevant information for creating a partition.

- a. To specify the mount point of a partition, either select it from the Mount Point drop-down list or type it in the field provided. We selected / in order to create the root partition.
- b. If you have more than one hard drive in your system, the partition will be created on any one of the selected drives. Unselect all drives except the one that is to hold the partition. The blue line indicates that the / root partition should only be created on sda.

**Note:** /dev/sda is the first disk connected to a SCSI controller in the machine. Subsequent disks will be sdb, sdc, etc. If you have multiple controllers the disks will be numbered sequentially starting on the first controller and then continuing on the second controller. Depending on the implementation of the RAID controller in your machine it could be known as /dev/sda for a IBM ServerRAID Controller or /dev/ida/c0d0 for a Compaq Smart Array Controller. The first IDE drive would be /dev/hda.

- c. Enter the size of the partition. Since we have a 4 GB (4000 MB) drive and need 512 MB for swap and roughly 500 MB for /var, we allocated 3 GB to the root partition. Refer to Table 1-2 on page 5 to determine the appropriate size of swap partition for your system.
- d. In the Additional Size Options box, you have several options. We selected **Fixed size** since we wish to specify a 3 GB partition size.
- e. Since it is safer to boot off a primary partition, we recommend that you select **Force to be a primary partition** for the boot partition (the partition that contains your root file system).
- f. Select **Check for bad blocks** to be confident your drives are in good shape; this will take quite a bit of time for large drives.

**Tip:** To be safe, you should always select **Check for bad blocks** for all partitions you create.

- g. Click **OK** once all information is entered correctly to create the partition.
13. To create the Swap partition, click **New** on the Disk Setup Screen. (The same step was illustrated in Figure 1-9.)

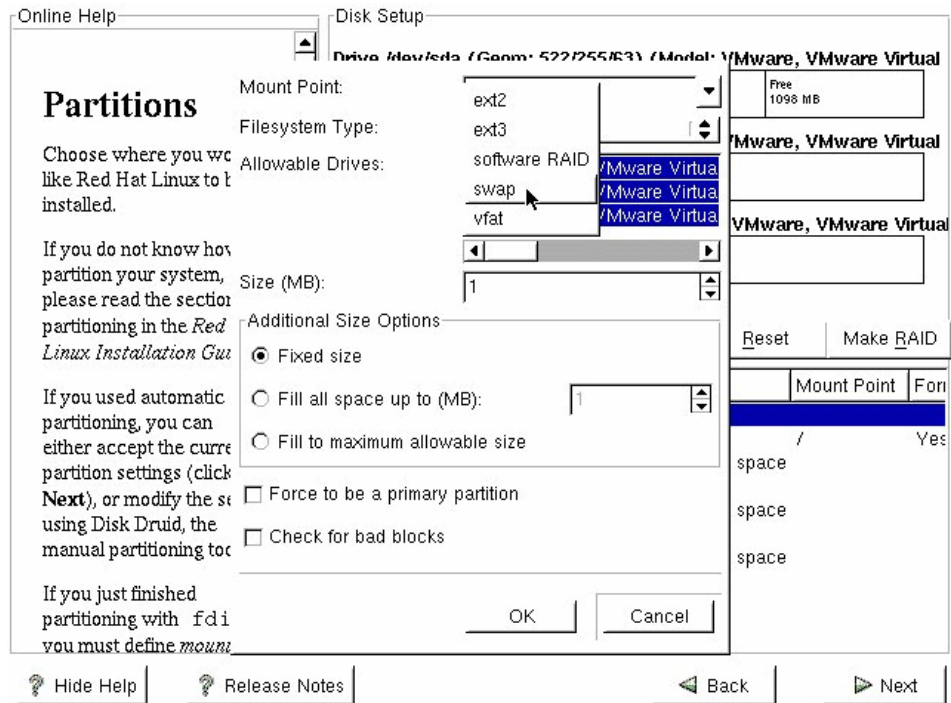


Figure 1-11 Red Hat 7.2: Selecting swap as the filesystem type

14. Click the **Filesystem Type** drop-down and select **swap**, as shown in Figure 1-11.

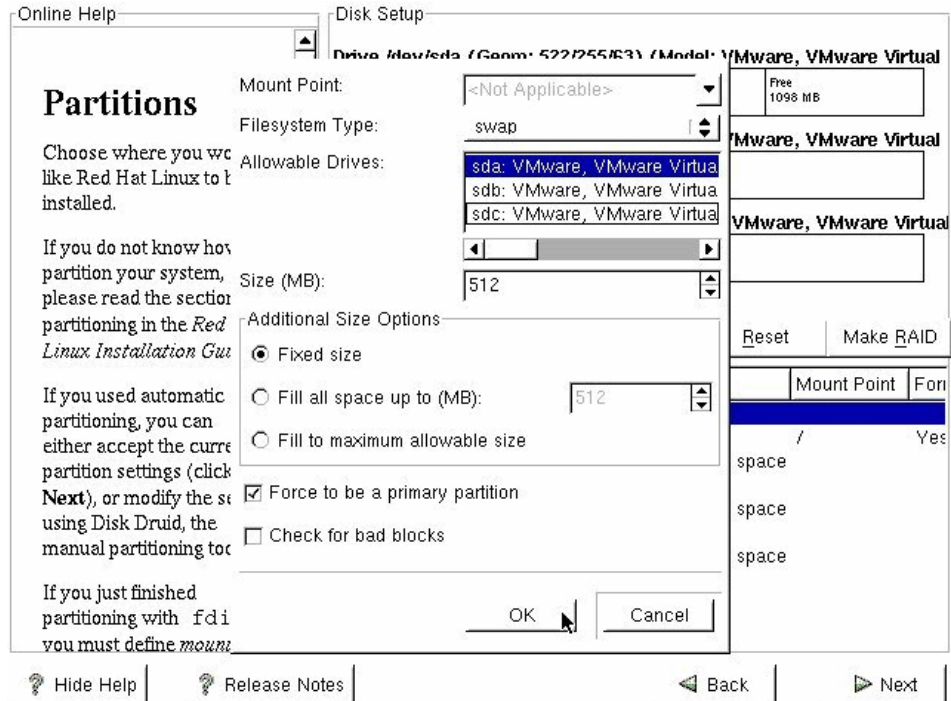


Figure 1-12 Red Hat 7.2: Creation of the swap partition

15. Select the appropriate disk array (sda in our case) from the Allowable Drives list, enter the size of the swap partition, and select **Fixed Size**. Click **OK** to create the swap partition. Our choices are shown in Figure 1-12.

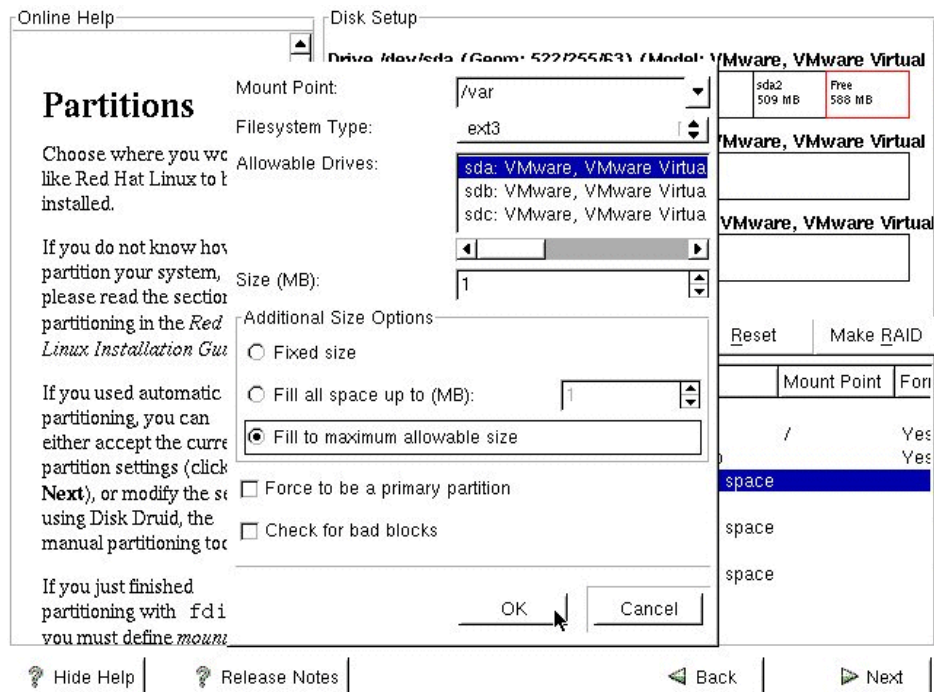


Figure 1-13 Red Hat 7.2: Creation of the /var partition

16. Create the /var partition in the same manner described previously for the other partitions on sda. Since this is the last partition you are going to create on sda, you can select **Fill to maximum allowable size** to use all remaining space. We left about 500 MB for the /var partition, which is plenty for our logging purposes. The results of our selections are shown in Figure 1-13.



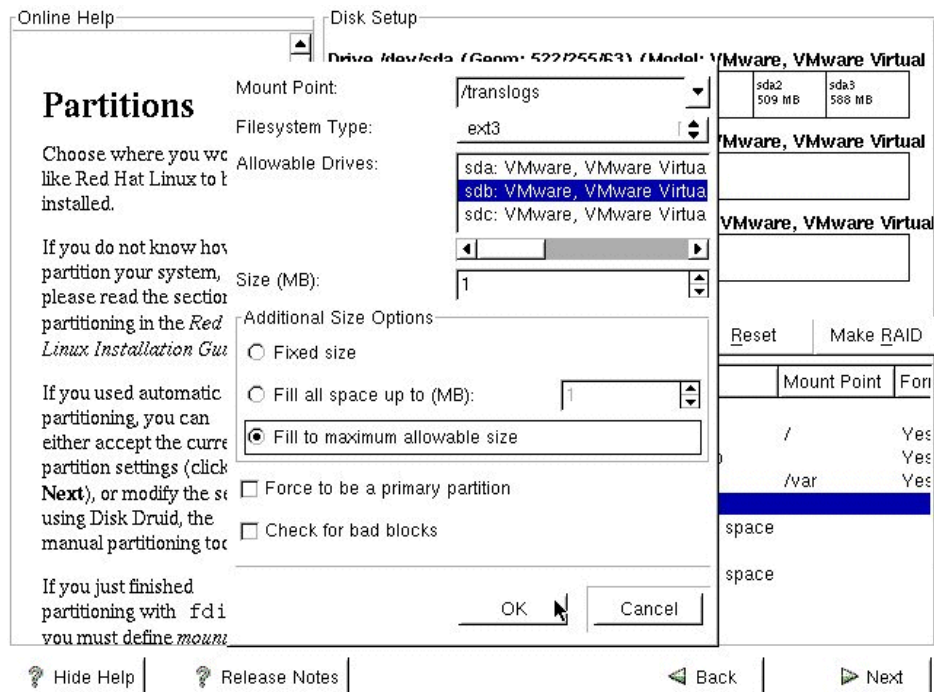


Figure 1-14 Red Hat 7.2: Creation of the /translogs partition

- The next partition you need to create is /translogs for the Domino Transaction Logs. Type /translogs into the Mount Point field; this is how you enter a mount point not available in the drop-down list. Since /translogs will utilize the entire disk, specify disk array **sdb** in the Allowable Drives section, then select **Fill to maximum allowable size** as shown in Figure 1-14. This is the easiest way to utilize the entire disk. Click **OK** to create the partition.

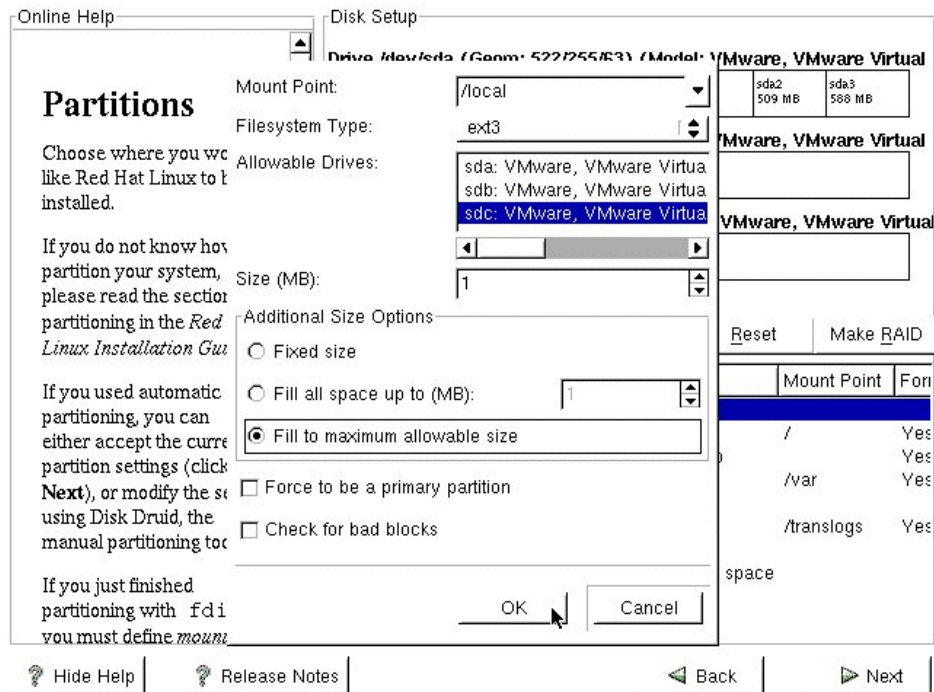


Figure 1-15 Red Hat 7.2: Creation of the /local partition

18. Click **New**, then enter /local in the Mount Point field. Specify that the partition should be created on **sdc**, and that it should use all available space. Figure 1-15 shows our selections.

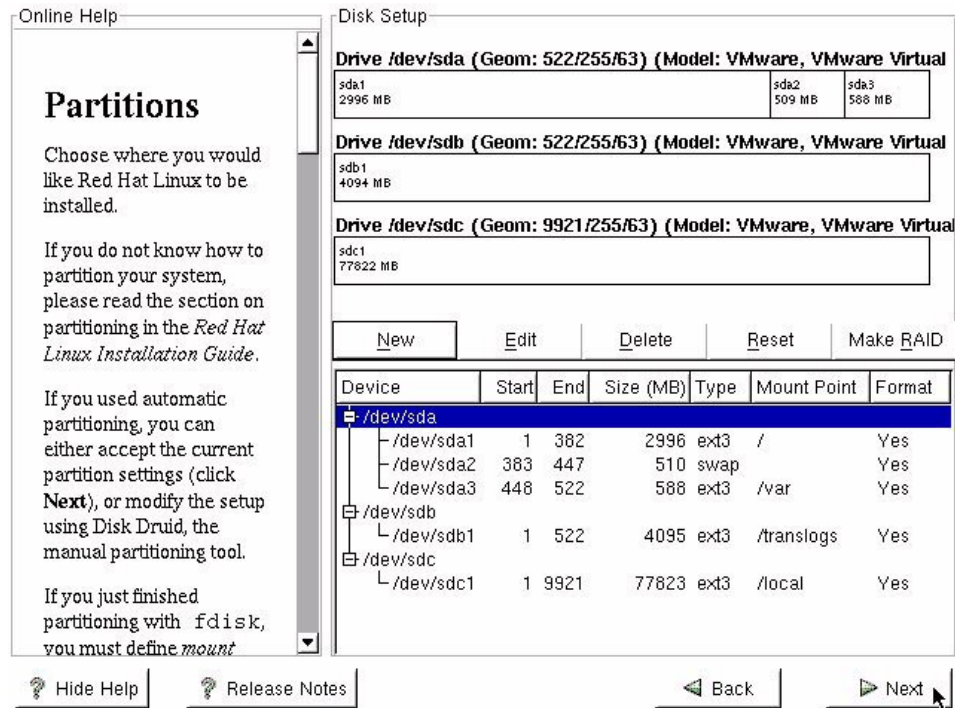


Figure 1-16 Red Hat 7.2: Final partition list

- All the partitions created are shown in Figure 1-16. Click **Next** to write the partition table to disk.

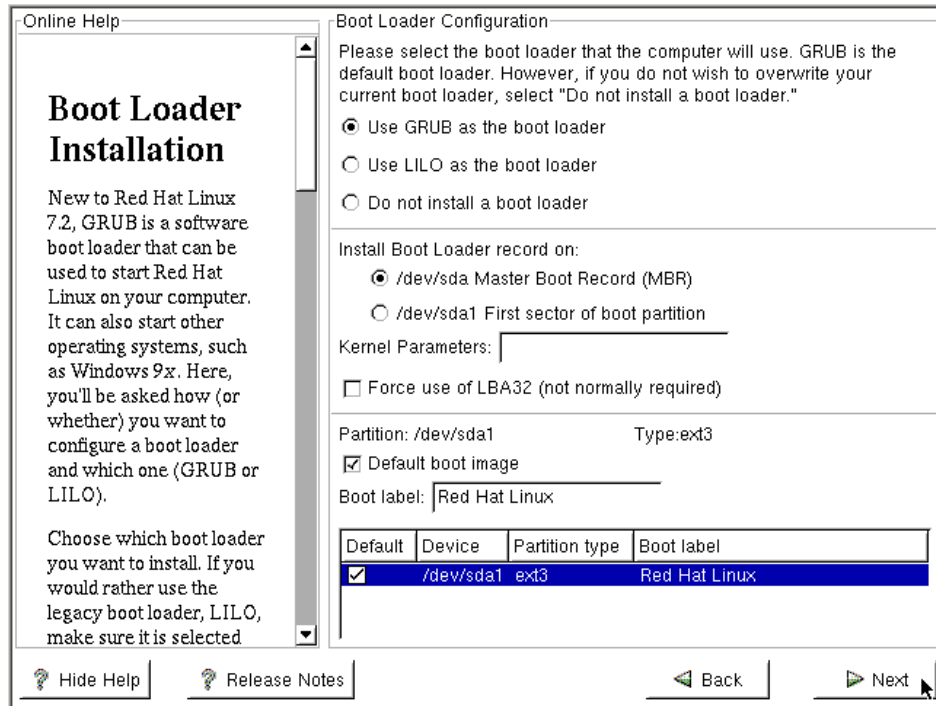


Figure 1-17 Red Hat 7.2: Boot Loader installation

**Attention:** If the boot partition of the system you are installing is on an IDE hard drive and it is stored on a section of the hard drive that is located beyond 1024 cylinders, select **Force use of LBA32**. The boot loader has to do special processing to address more than 1024 cylinders when booting the system from such a partition.

20. Figure 1-17 shows the boot loader options.

A boot loader is the first software program that runs when a computer starts. It is responsible for loading and transferring control to the operating system kernel software, which then loads the operating system. A boot loader can be used to start Linux and other operating systems, such as Windows or OS/2. Examples of boot loaders are GRUB and LILO for Linux and NTLDR for Windows NT/2000.

We used GRUB (Grand Unified Boot Loader) for our installation because it is the default boot loader for Red Hat. Be sure to specify that the boot record should be installed in the MBR (Master Boot Record). All other default options can be accepted.

**Tip:** If you are removing Linux from a machine and re-installing another operating system, you need to first clear the Master Boot Record. Otherwise, the system will try and boot Linux, which was just overwritten with the re-installed operating system.

To clear the MBR, first boot up with a Windows 98 diskette, and run the following command:

```
FDISK /MBR
```

Now you can reboot the system and start the installation of your new OS.

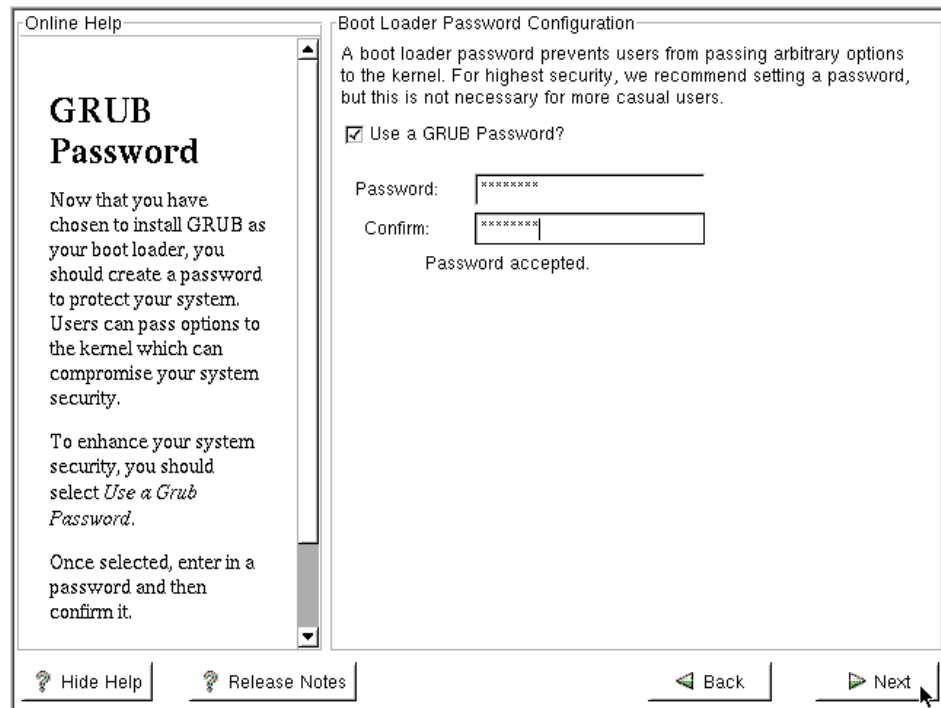


Figure 1-18 Red Hat 7.2: GRUB password

21. You can set a password to protect GRUB as shown in Figure 1-18. We recommend that you set a password to prevent unauthorized changes to the GRUB boot parameters. If the password is too short, a message will be displayed and you will have to enter a longer password.

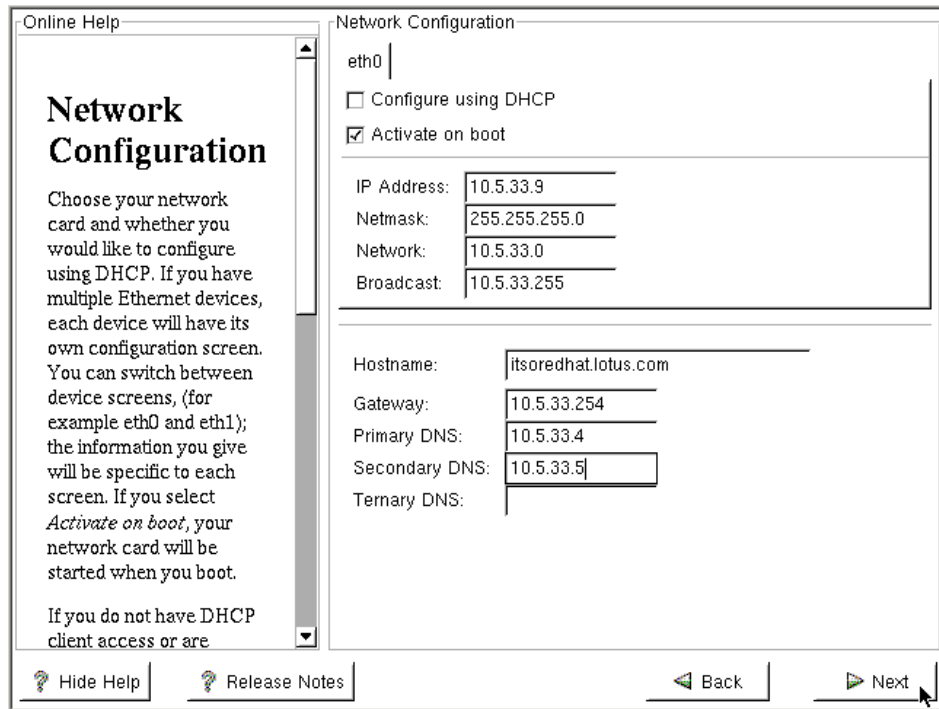


Figure 1-19 Red Hat 7.2: Network configuration

22. Figure 1-19 shows the window used to set up networking. Enter the following information:

- Deselect Configure using DHCP.
- Select **Activate on Boot**.
- Enter a suitable IP Address, Netmask, Hostname, Gateway, and Domain Name Server; the Network and Broadcast addresses are automatically calculated for you. These are the lowest and highest IP Addresses of your IP Network. If you have alternate DNS servers, they can be specified in Secondary DNS and Tertiary DNS.
- Click **Next** to continue.

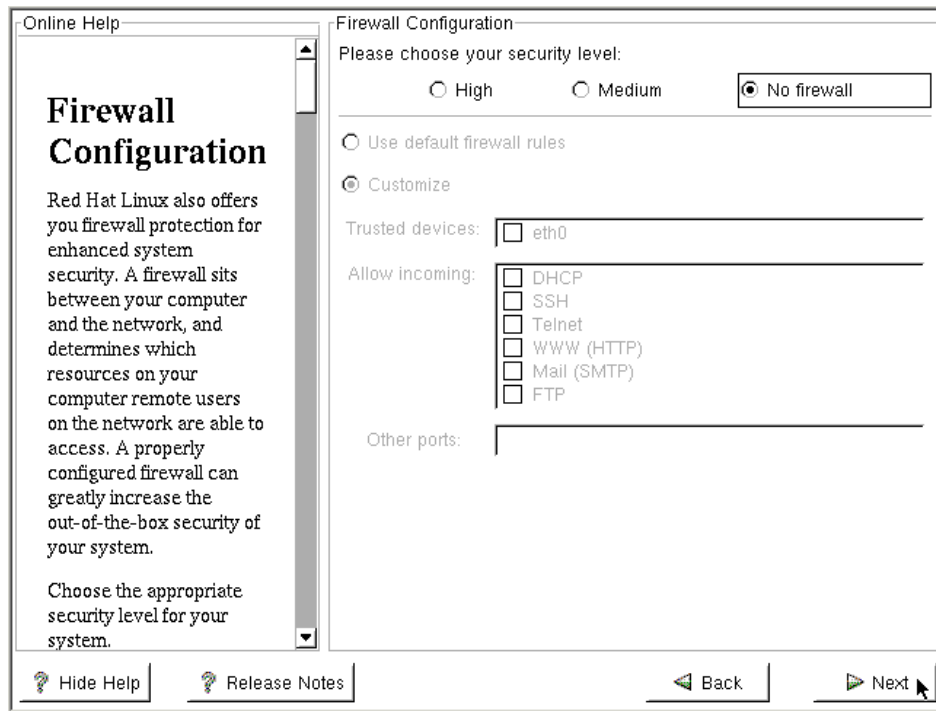


Figure 1-20 Red Hat 7.2: Firewall configuration

23. Red Hat gives you the option to utilize a firewall. Since our network has a dedicated firewall, we chose not to install one on the server. Click **Next** to continue.

**Note:** For performance reasons the Domino server should not act as a firewall.

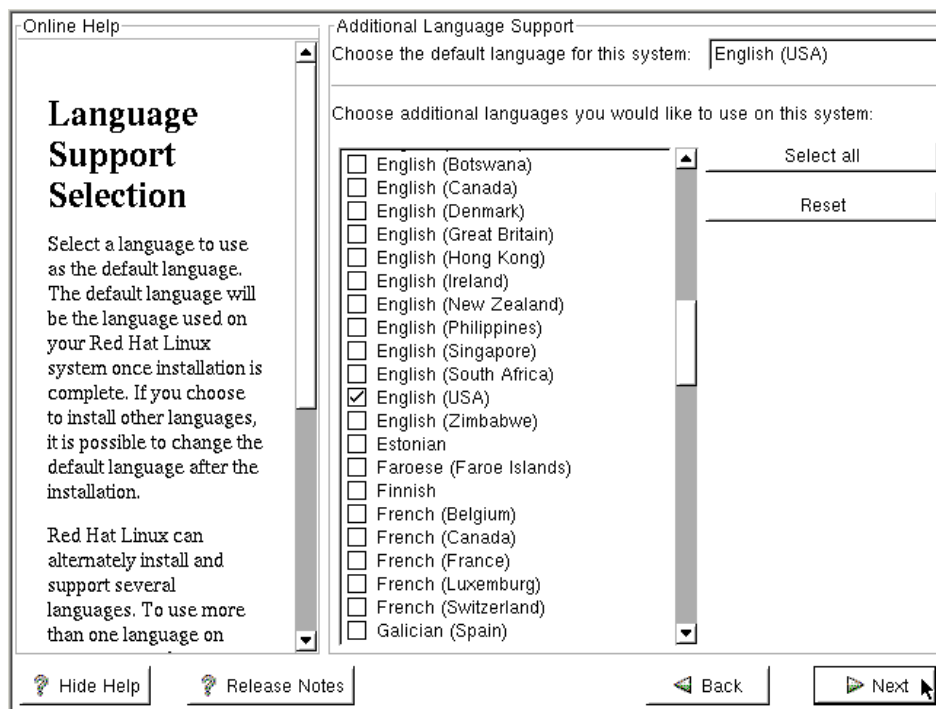


Figure 1-21 Red Hat 7.2: Language support selection

24. Select the default language, and any additional languages, that will be used on your Red Hat system after installation.



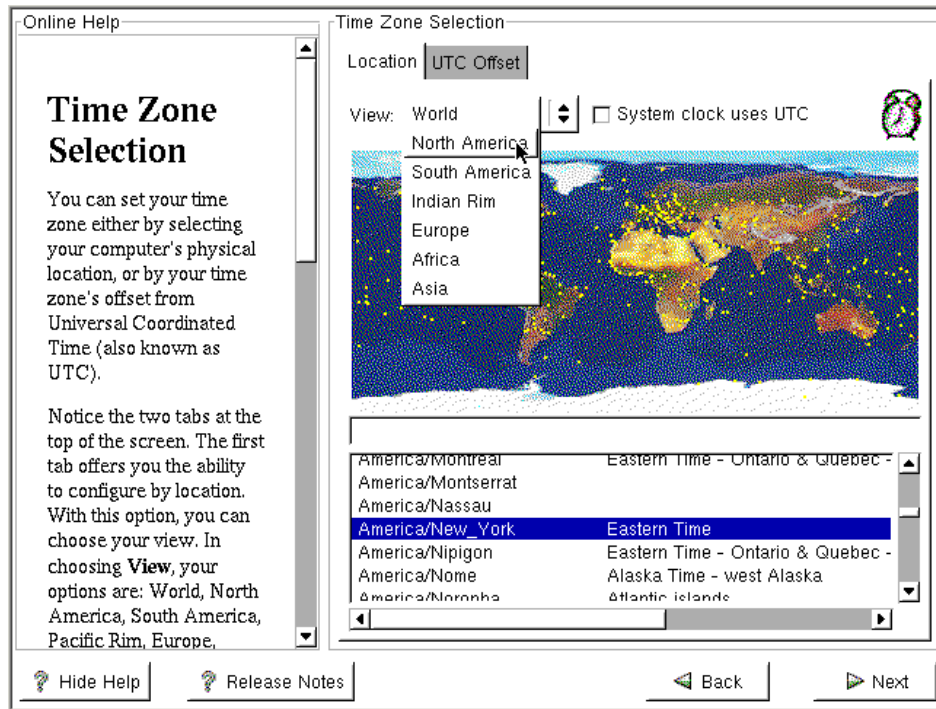


Figure 1-22 Red Hat 7.2: Time zone selection

25. The Time Zone Selection window is displayed as shown in Figure 1-22. Set the correct time zone for your installation. Be sure to choose the correct hardware clock setting for your system. If your PC's clock is set to UTC or GMT, select **System clock uses UTC**. Change the view of the map by selecting your area from the View drop-down list. Select your time zone by clicking on a specific city. Click **Next** once you have made your selections.

**Tip:** For countries with Daylight Saving, we recommend that you set the BIOS clock to GMT and select **System clock uses UTC**.

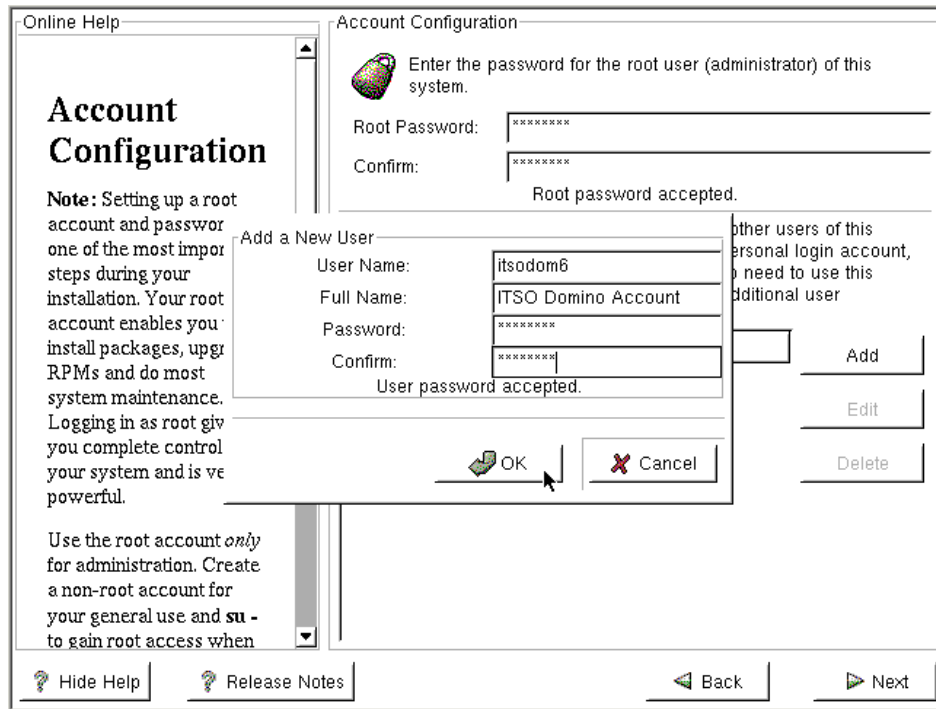


Figure 1-23 Red Hat 7.2: Root password and Notes account creation

26. Enter the password you want to set for the root user. The root user is also known as the *Super User*, and is equivalent to the NT Administrator account. This account has full control over the system.

You should add at least one user to the system to proceed, so you might as well add the Notes account now. Once the root password has been accepted, click **Add** to add a new user to the system as shown in Figure 1-23. After you enter the requisite information and click **OK**, you can add more users or click **Next** to continue.

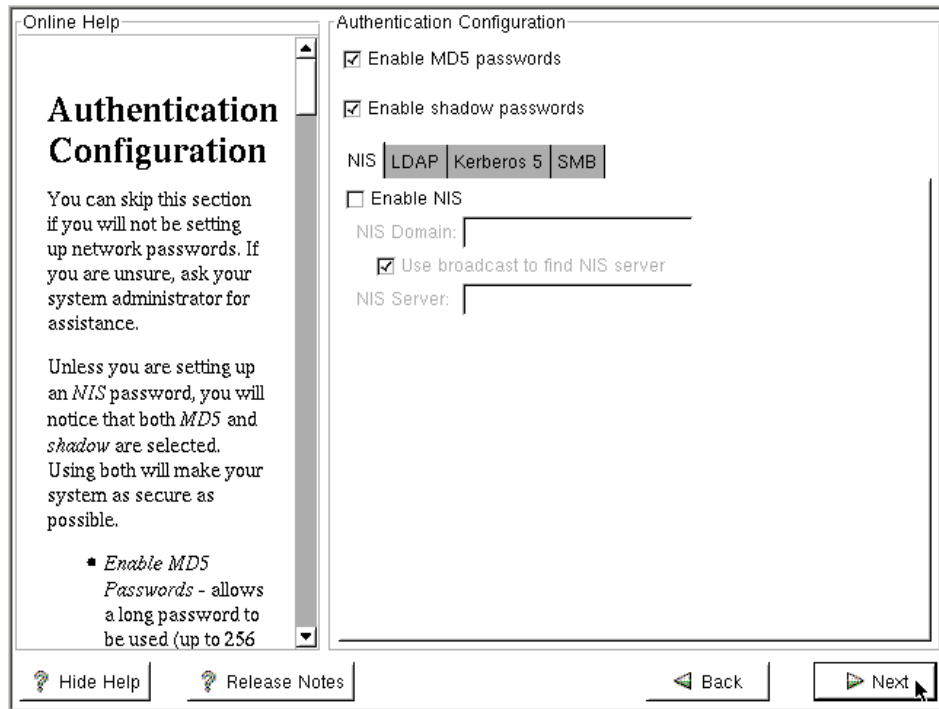


Figure 1-24 Red Hat 7.2: Authentication configuration

27. The Authentication Configuration screen is displayed. Make certain both **Enable MD5 passwords** and **Enabled shadow passwords** are checked, then click **Next** to continue.

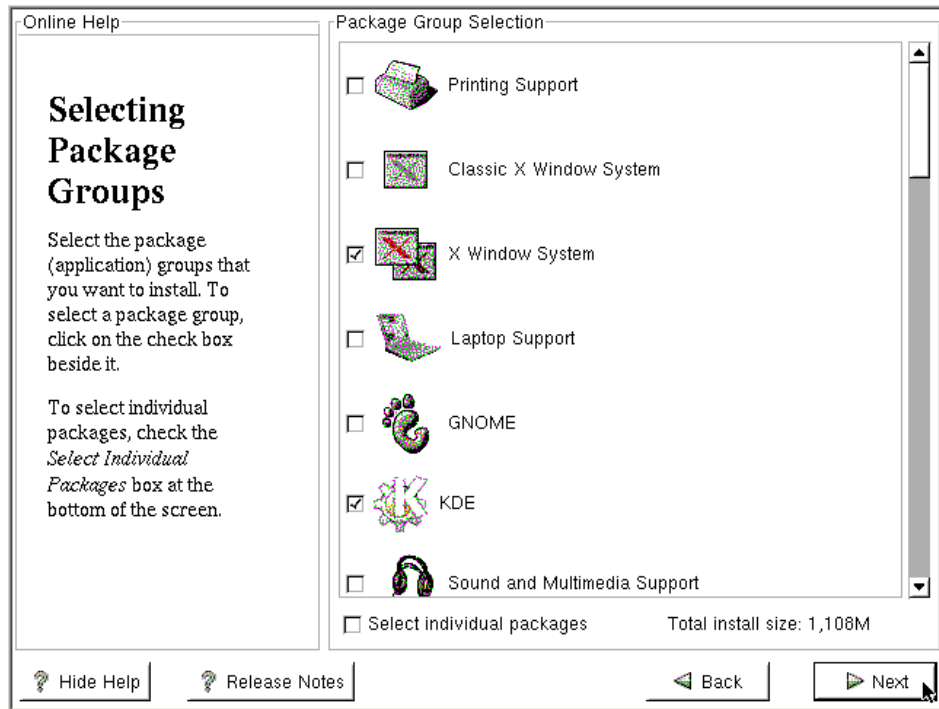


Figure 1-25 Red Hat 7.2: Package selection

28. The Package Group Selection screen is displayed. Use the scroll bar on the side of the screen to see more selections. If a box has a check mark, the package is selected for installation; if it is blank, it will not be installed. We recommend that you select the same packages for your installation as we did. If you are going to use Gnome for your graphical user interface (GUI), you do not need to select KDE unless you want both GUIs available to your administrators. In order to add other packages, such as telnet or ftp, simply check the "Select individual packages" checkbox shown in Figure 1-25. The packages we selected are:

- X Window System - The base X-Window manager
- KDE - Graphical user interface
- Network Support - Allows TCP/IP networking
- Utilities - Various system utilities
- Software Development - Various compilers needed for system adjustments

- Kernel Development - Useful for a number of reasons, including allowing you to recompile the kernel to reduce its size by removing unnecessary drivers

Deselect everything else and click **Next** to continue.

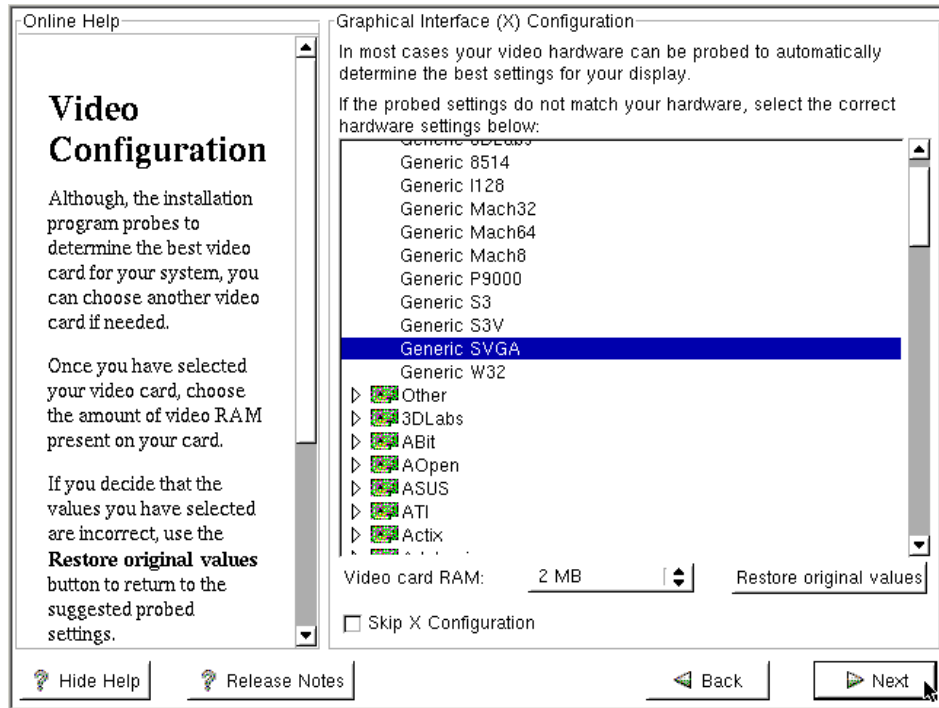


Figure 1-26 Red Hat 7.2: Video configuration

29. The Graphical Interface (X) Configuration screen is displayed. The installation will select a card based on the results of its probe; you can override this and select the graphics card that is installed in your machine from the list. If you are uncertain of the specific card installed in your system, *Generic SVGA* will usually work.

Click **Next** once you are satisfied with the selections.

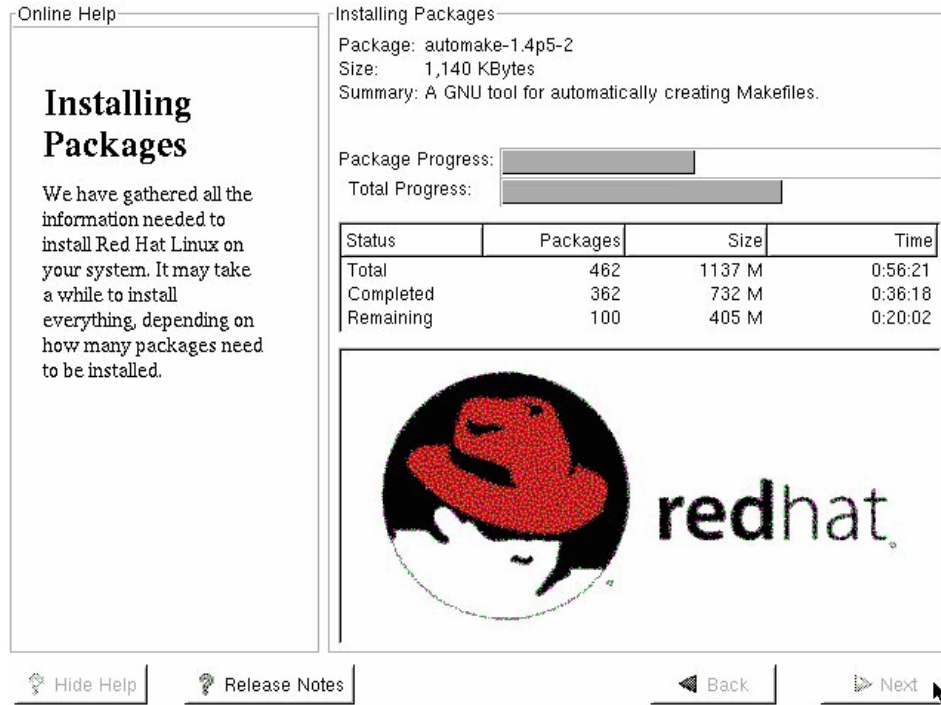


Figure 1-27 Red Hat 7.2: Installation of packages

30. The install program is now ready to copy the software from the CD-ROM to your hard disk drive. Click **Next** to start the process as shown in Figure 1-27.

First, the partitions will be checked for errors, then they will be initialized (formatted). Once this is done, the actual installation begins.

After all packages are copied from the first CD, you might be prompted to insert additional CDs depending on the packages selected. When prompted, change CDs and click **Continue**.

**Note:** If you are installing from DVD you will not have to change the disc.

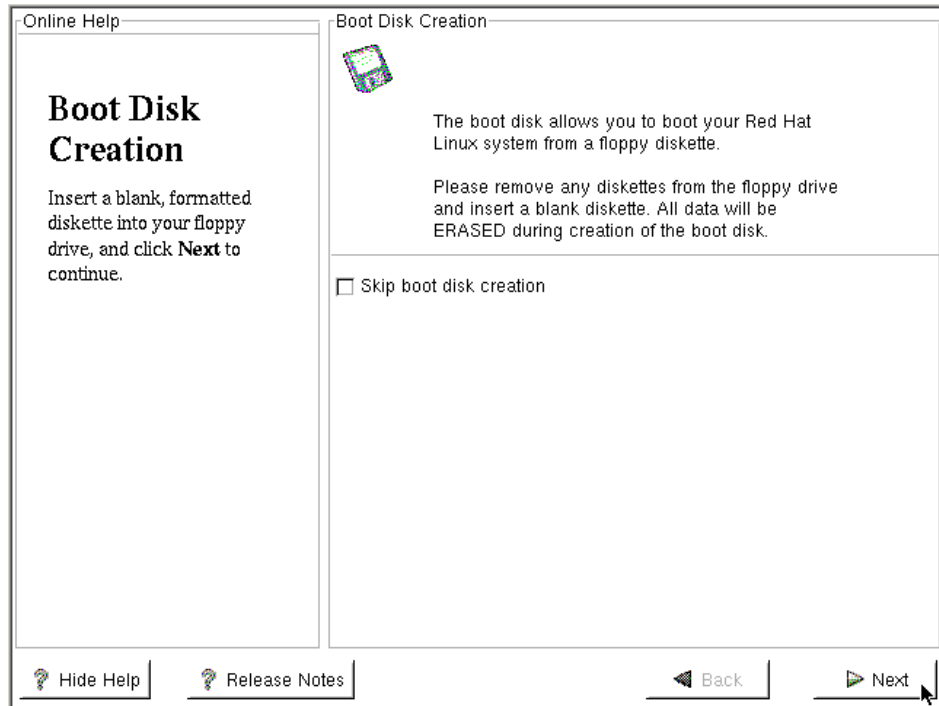


Figure 1-28 Red Hat 7.2: Boot disk creation

31. Once the install is complete, you can create a boot disk. We recommend that you create this boot disk and keep it in a safe place. This disk will be used to recover your system should it become unbootable. Insert a floppy disk that can be overwritten into the floppy drive of your machine and click **Next** to create the boot disk.

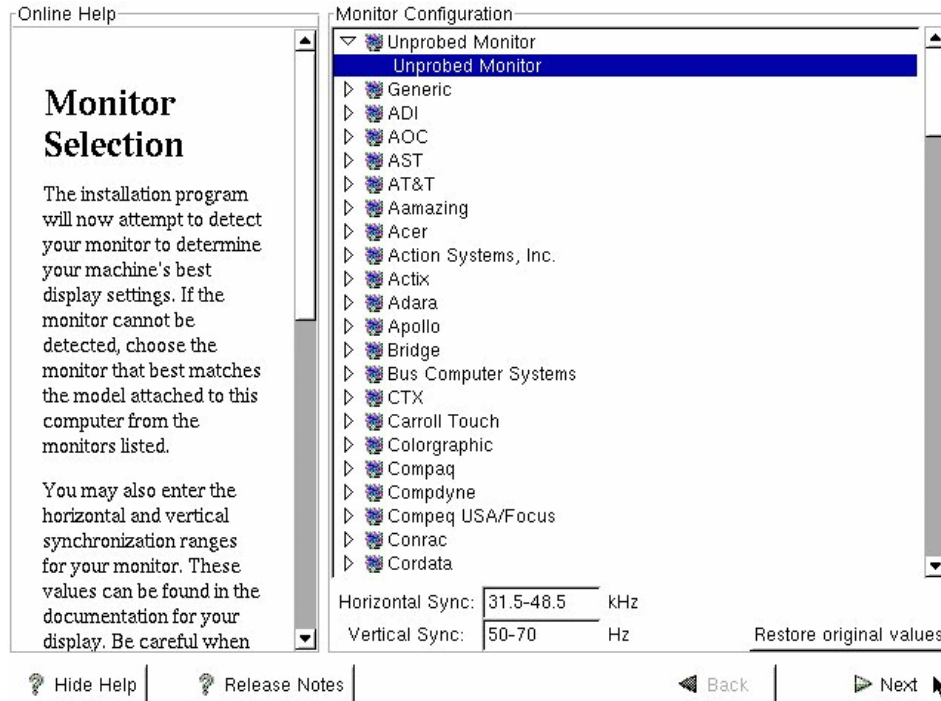


Figure 1-29 Red Hat 7.2: Monitor selection

32. On the Monitor Configuration screen, specify the Monitor that is attached to your machine.

We selected a Generic Monitor with a 1024x768 resolution since it will generally work on all monitors. If your monitor is not listed, and you know the capabilities of your monitor, specify the Horizontal and Vertical refresh rates that your monitor supports. Click **Next** to continue.



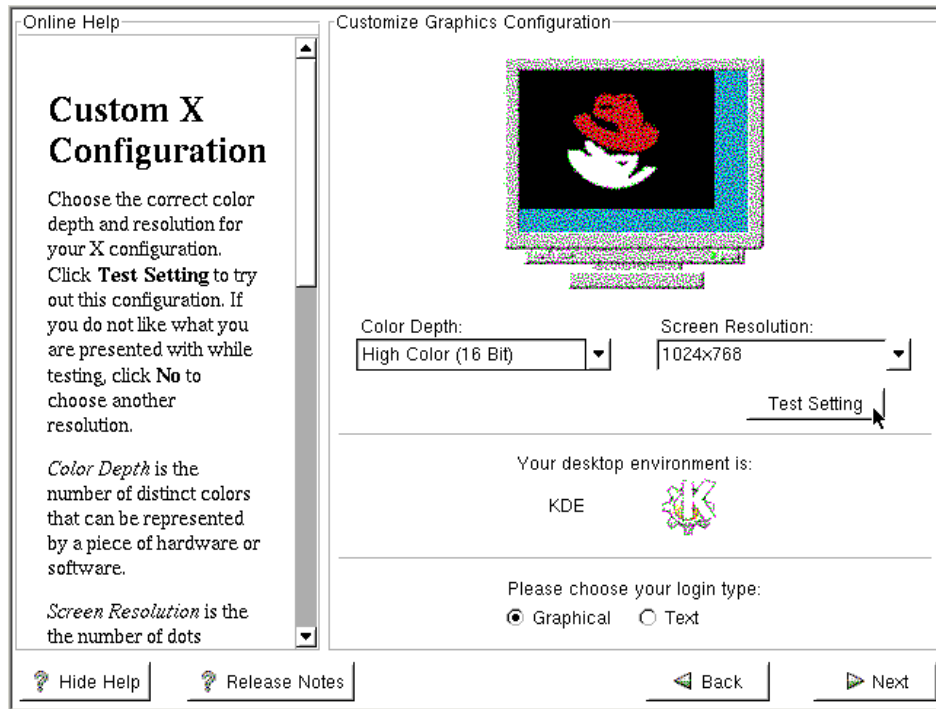
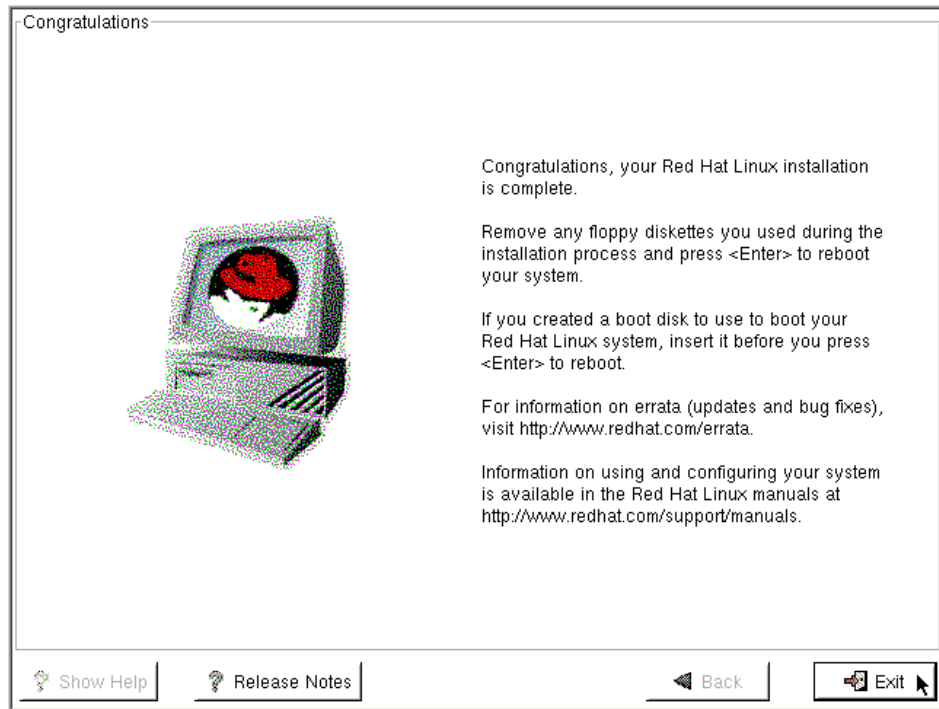


Figure 1-30 Red Hat 7.2: Custom X configuration

33. On the Customize Graphics Configuration screen (Figure 1-30), you can select the color depth, screen resolution, desktop environment, and login type. We recommend that you run a graphical login, using the KDE desktop with 1024x768 screen resolution. Once you have made your selections, click **Test Setting** to ensure that your system will function once you reboot. Once the screen displays correctly, click **Next** to accept your settings.



*Figure 1-31 Red Hat 7.2: Installation complete screen*

34. When the window shown in Figure 1-31 is displayed, the installation of Red Hat 7.2 is complete. Click **Exit** to restart the system.

This completes the Red Hat 7.2 Installation process.

If you would like to view the KDE logon process, you can take a look at step 38 on page 80 since KDE is very similar for both Red Hat 7.2 and SuSE 8.0.

## 1.3 Installing SuSE Linux 8.0

In this section, we show you how to install SuSE Linux 8.0 on your server.

**Note:** We recommend using SuSE Linux Groupware Server 7 with Lotus Domino or newer—instead of the SuSE Linux 8.0 Personal or SuSE Linux 8.0 Professional version. SuSE Linux Groupware Server contains SuSE Enterprise Server 7 and Lotus Domino Server. The SuSE Enterprise Server version has an extended release cycle. The SuSE Enterprise Server has also been certified by the top ISVs, such as IBM. The installation of the SuSE Groupware Server is similar to the installation of the SuSE Professional version, which we detail here.

To capture the screens you see in this book, we installed and configured Linux in a VMware window. VMware allows you to run one operating system as a guest of another. This means that some of the screens might look slightly different from what you would see on your system. These differences are hardware-related, as VMware emulates different hardware devices for the guest operating system.

Additional information about VMware is available on the VMware, Inc. website at: <http://www.vmware.com>

Be sure to read “Before you begin” on page 2 in order to make the installation easier.

To start the installation, insert the SuSE 8.0 CD-ROM/DVD and turn on or reboot the server.

**Attention:** The installation process will destroy any existing data stored on your hard disk drives.

```

Welcome to SuSE Linux!

To start the installation, just press <return>.

Available boot options:

linux      - start installation (this is the default)
manual     - manual installation
failsafe   - installation with some options that are needed on tricky hardware
              (it is in fact equivalent to "linux ide=nodma apm=off acpi=off")
apic       - start installation, use kernel with APIC support
rescue     - start rescue system
harddisk   - boot installed system

Have a lot of fun...

boot: _
F2=Text mode  F3=640x480
```

Figure 1-32 SuSE 8.0: Welcome screen

1. When the screen shown in Figure 1-32 is displayed, you are ready to start the Linux installation. Ensure that **F3=640x480** is highlighted and press **Enter** to begin the installation, or wait for it to start automatically after a short pause. Once the kernel is booted and all device drivers are loaded, the SuSE installation process is ready to install the operating system. If the graphical installation fails to start, see the SuSE installation manual.

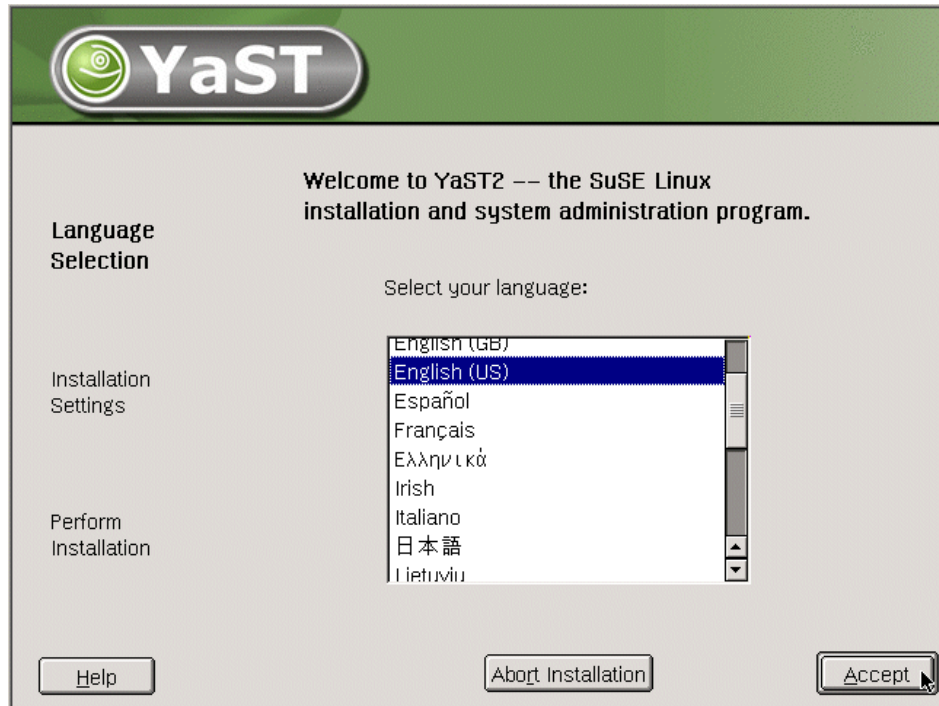


Figure 1-33 SuSE 8.0: Language selection

2. As shown in Figure 1-33, you can select the language you would like to use on your system. Specify the appropriate language and click **Accept**.

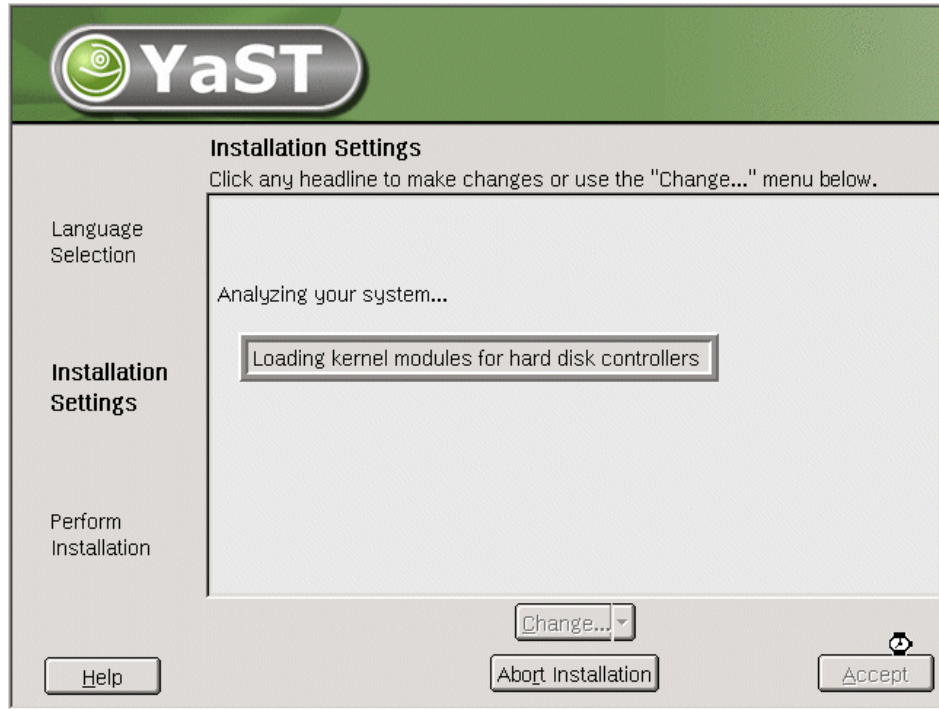


Figure 1-34 SuSE 8.0: Analyzing system

3. The system will begin to probe (detect) the hardware installed in your system and load the appropriate drivers for it. While this is happening, the screen shown in Figure 1-34 is displayed.

**Note:** Some disk controllers require drivers supplied by the manufacturer and are not supported out of the box. See <http://sdb.suse.de/en/sdb/html/> for more information about installing disk drivers.

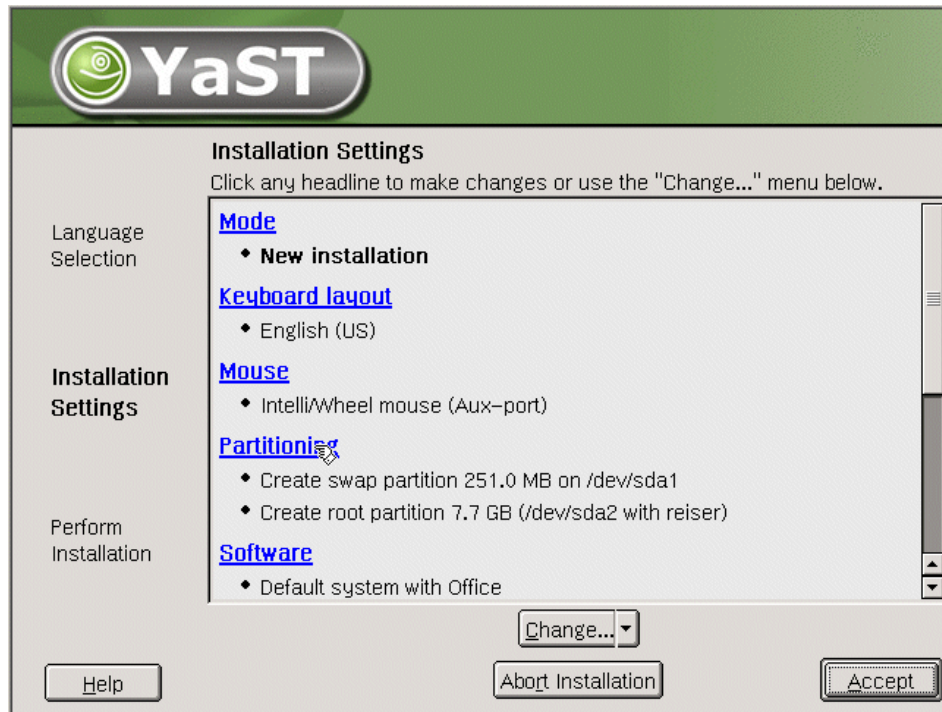


Figure 1-35 SuSE 8.0: Default installation settings

4. Once all hardware has been detected, you will see the window shown in Figure 1-35. You need to change the partitioning scheme since the installer's automatic settings do not provide an optimal partitioning scheme. Click on *Partitioning* to change the partition configuration.

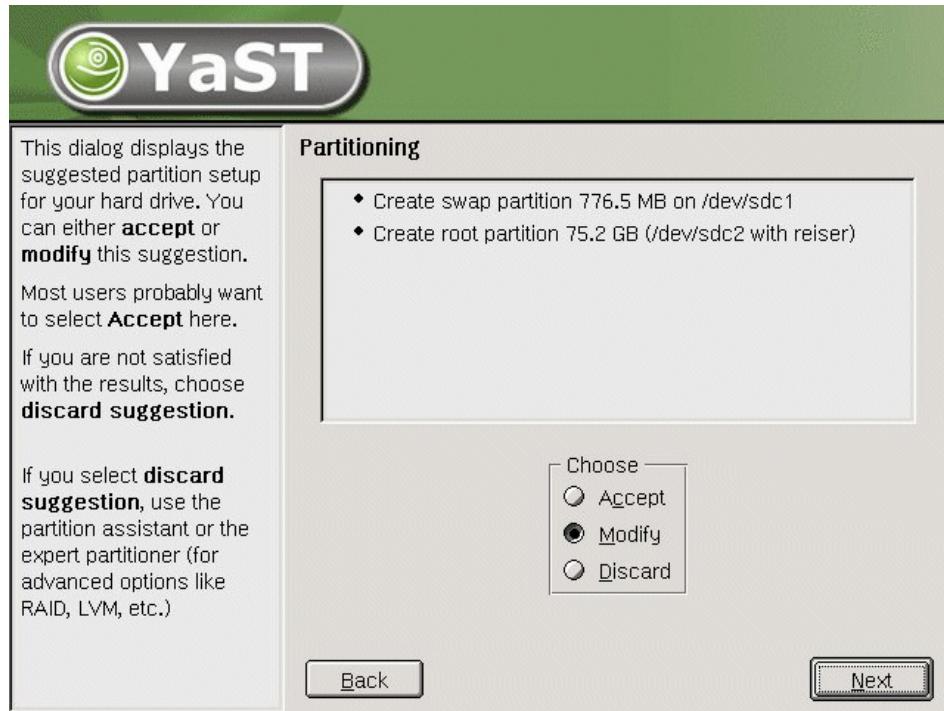


Figure 1-36 SuSE 8.0: Partitioning

5. Select **Modify** and click **Next** to change the partition configuration.

**Important:** You can only have four primary partitions for each hard disk drive. If you need to create more than four partitions, create three *primary* partitions and one *extended* partition that uses all the remaining disk space. You can then create all subsequent partitions in this extended partition.



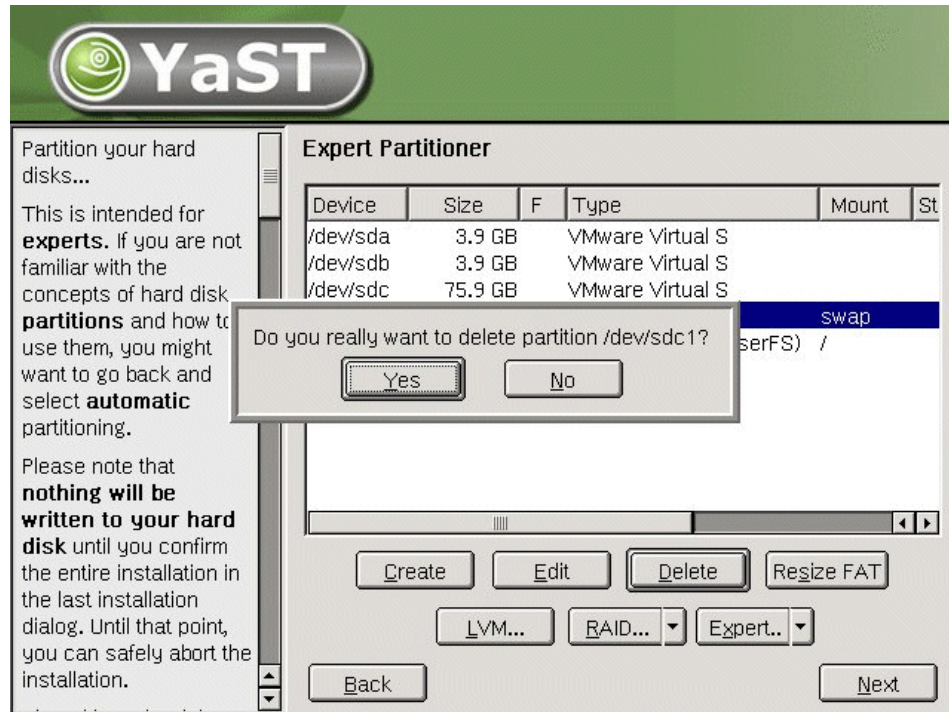


Figure 1-37 SuSE 8.0: Default partitions

- You will be shown the disks installed in your system and the current partitioning structure. (See 1.1.3, "Partitions" on page 4 for the recommended partitions and their respective sizes. You might also want to review 4.1.1, "Linux performance" on page 196 for alternate configurations using software RAID and LVM.)

There are two ways to change from the SuSE-selected structure to the structure used in this book. Select the partition and click **Delete** to remove it, or **Edit** to change its settings. If the default setup is close enough to your desired partition, it may be easier to edit the options. In these instructions, we describe how to delete all partitions and then set each one up.

First, you need to delete the Root partition the Installer has created. Select the Root Partition and click **Delete** to remove it. Click **Yes** to confirm that you want to delete the partition.

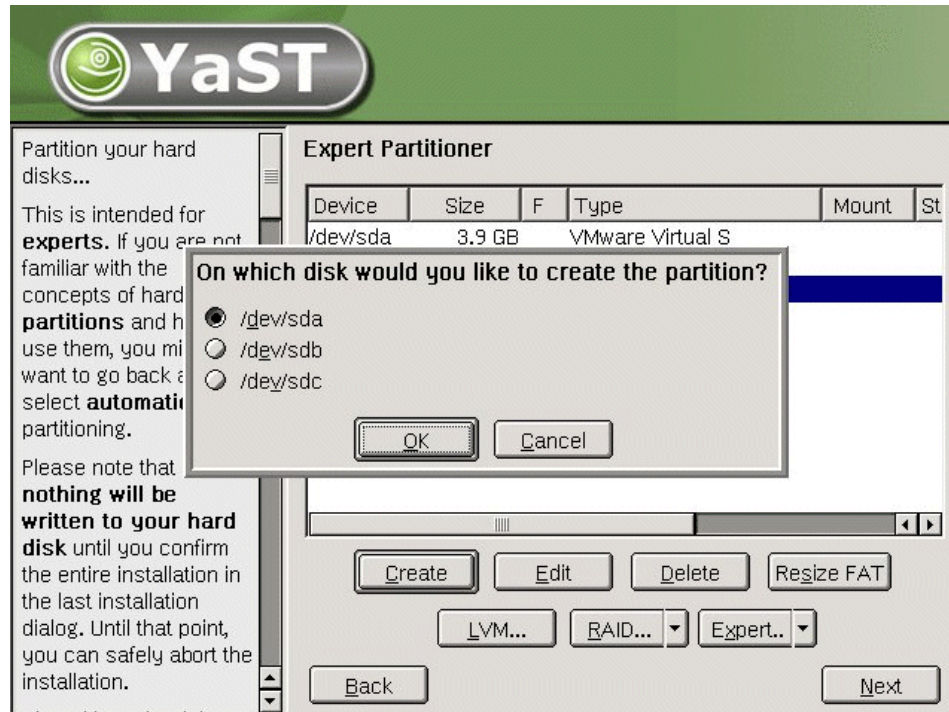


Figure 1-38 SuSE 8.0: Select disk for partition

7. Specify the disk on which the partition should be created. If you only have one disk or Raid Volume Set, you will not see this screen. Click **OK** once the correct disk is selected.

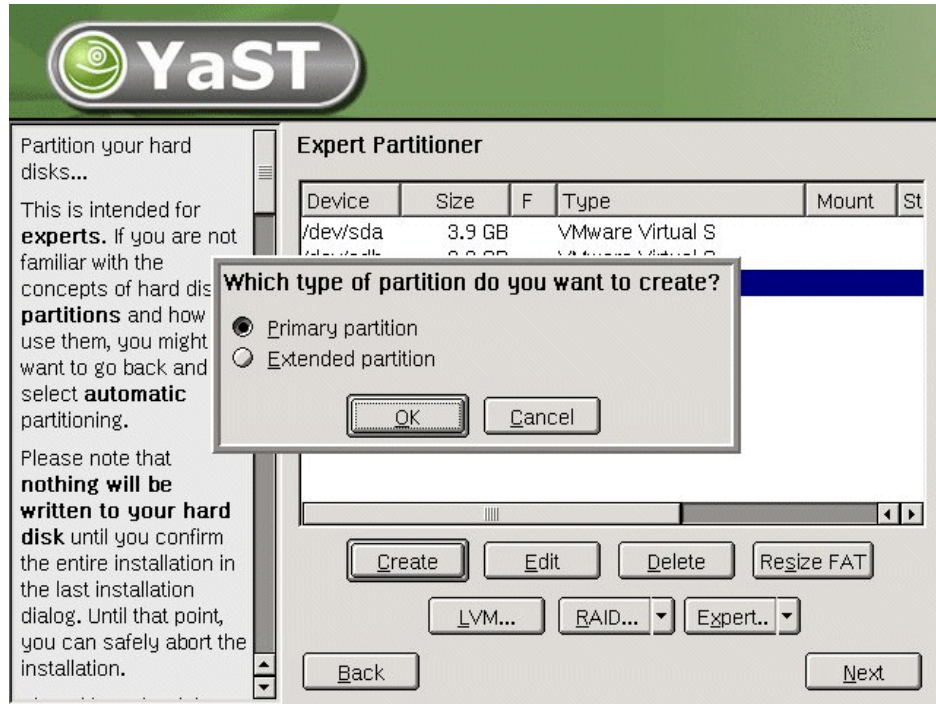


Figure 1-39 SuSE 8.0: Primary partition

8. Figure 1-39 shows the options to create either a Primary or Extended partition. For the root partition, select **Primary** and click **OK**.

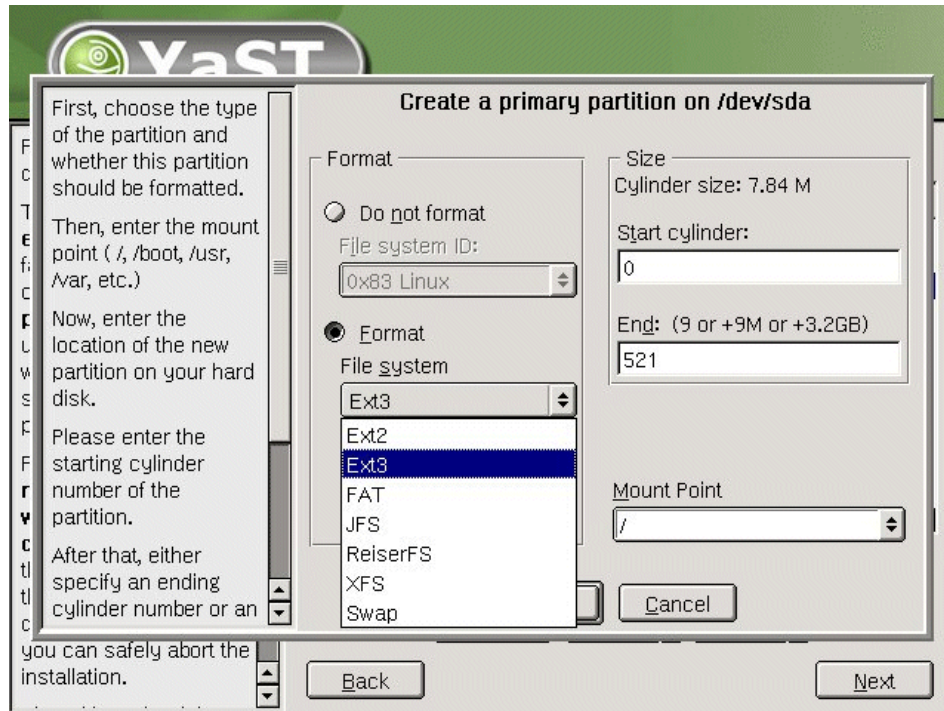


Figure 1-40 SuSE 8.0: Creation of / root partition

9. Select **Format**, then change the File system to **Ext3**.

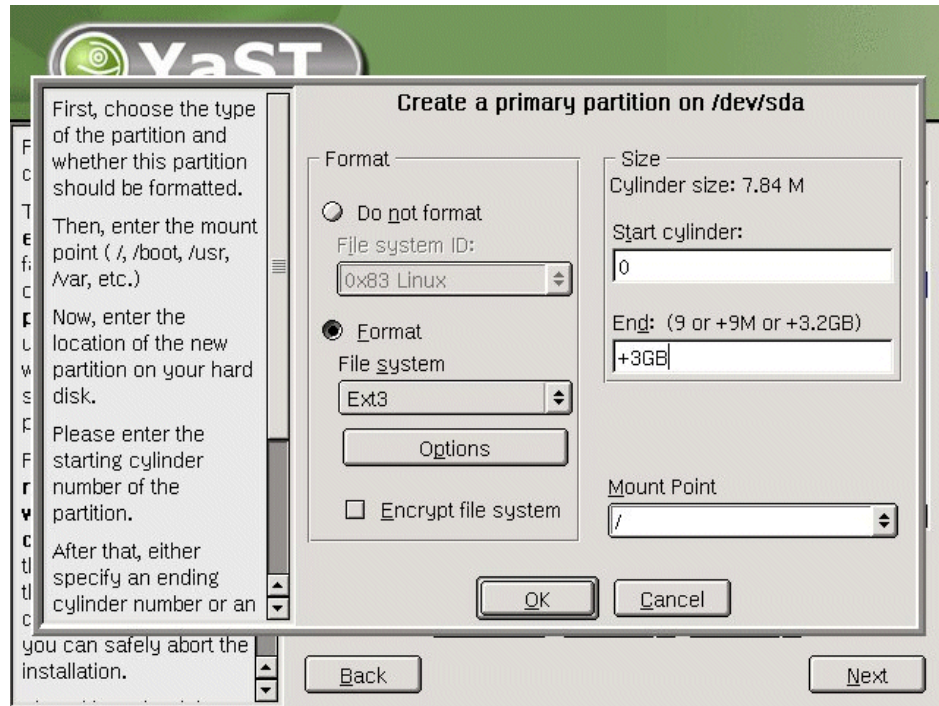


Figure 1-41 SuSE 8.0: Entering the size of the partition

10. In the Size section, enter the size of the partition. The default is to specify the start and end cylinders of the partition, but an easier method is to specify the size in megabytes or gigabytes by entering a plus sign, the size, and M or GB in the End field.

After you specify the size (we chose 3 GB based on a 4 GB drive) and the correct Mount Point (the default is /, which is correct for this partition), click **OK**.



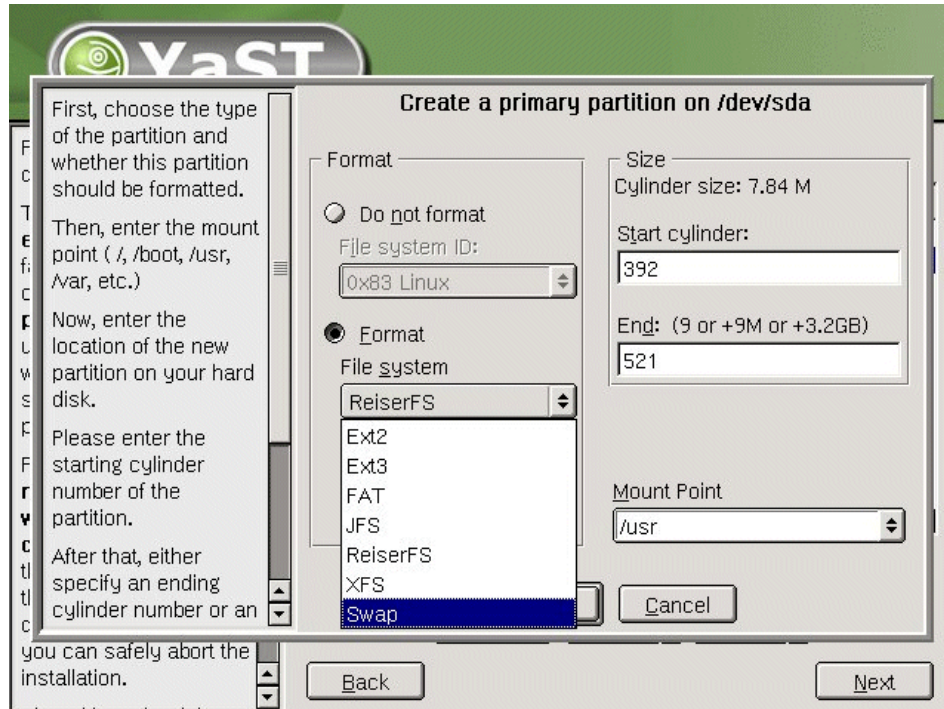


Figure 1-42 SuSE 8.0: Changing to Swap for the file system

11. Next you need to create the swap partition. Click **Create** and select the array as you did in step 7 on page 48, then select **Primary** as shown in step 8 on page 49.

Select **Format**, then change the File system to **Swap**.

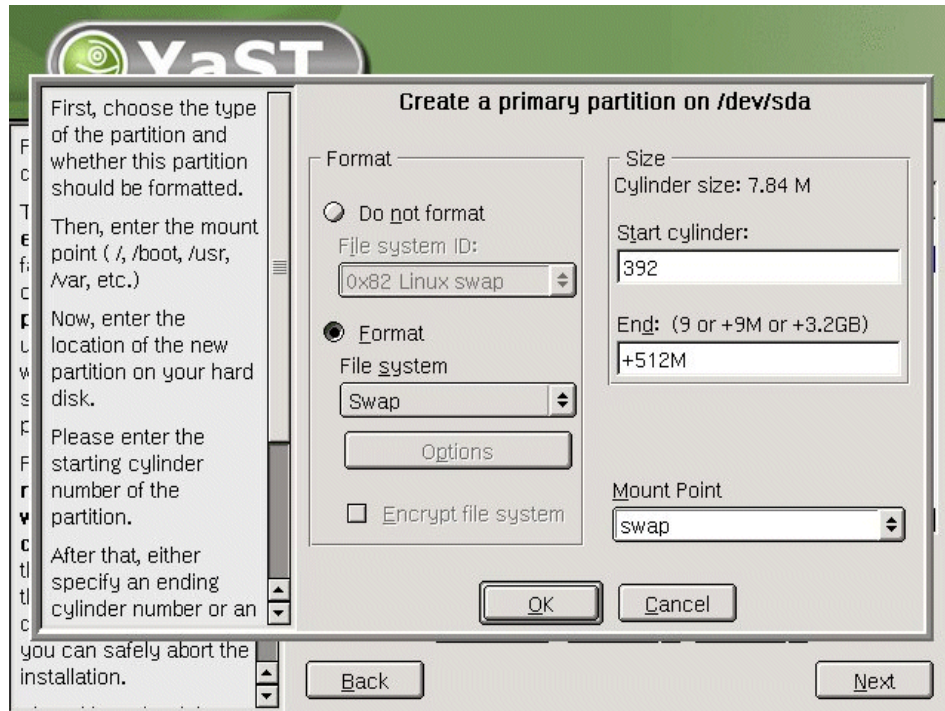


Figure 1-43 SuSE 8.0 : Entering the swap size

12. Enter the size of the swap partition. The installation will automatically calculate the start cylinder based on your previous selections, so you do not need to change this value. Click **OK** to create the swap partition.

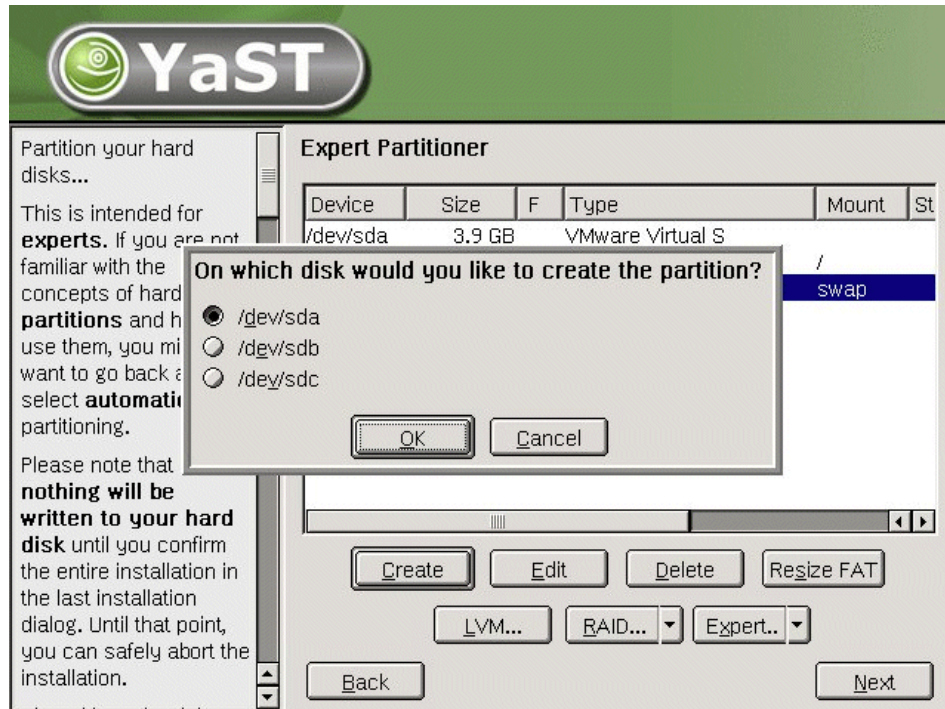


Figure 1-44 SuSE 8.0: Choosing a disk for the /var partition

13. Click **Create**, then select **Extended partition**. You can have up to four partitions per hard disk drive or array, so you could opt to create /var as a primary partition. We chose to create it as an extended partition to demonstrate how to do so. If you would like more traditional UNIX-style partitioning, then you would use an extended partition to allow you to create the additional partitions.



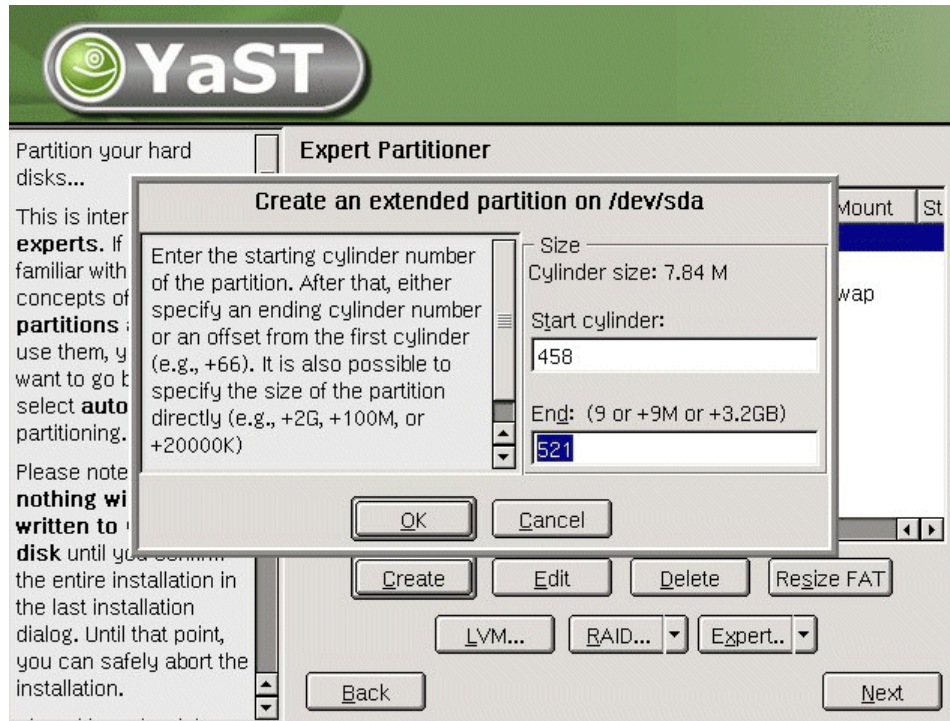


Figure 1-45 SuSE 8.0: Assigning remaining space to extended partition

14. You can accept the default value to use the remaining space. If you enter a value larger than the remaining space, SuSE will automatically reduce it to fit.

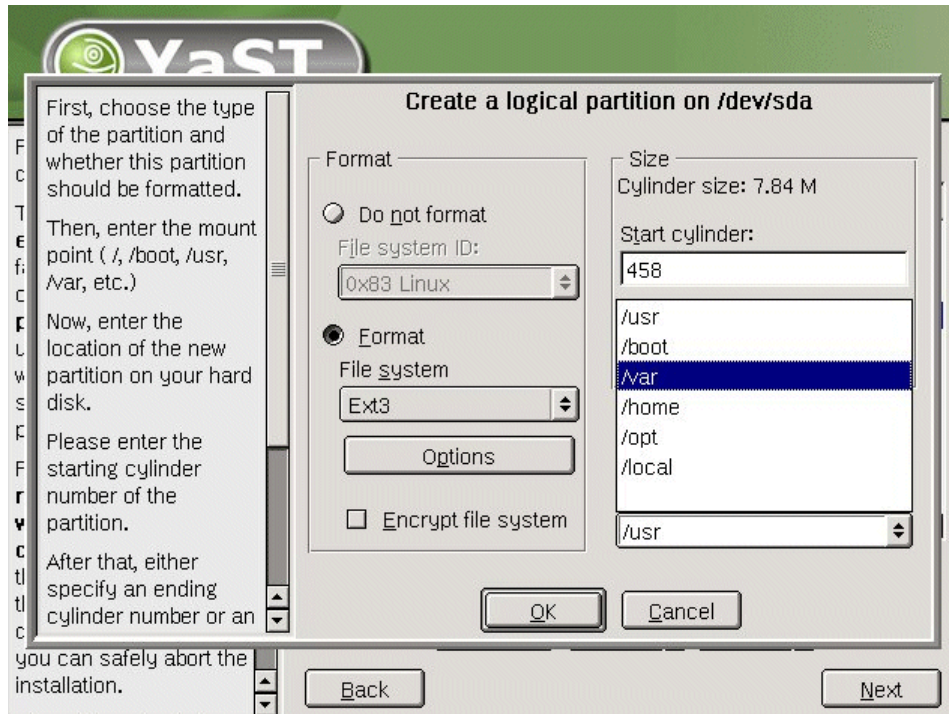


Figure 1-46 SuSE 8.0: Selecting /var as the mount point

15. Click **Format**, select **Ext3** from the File system drop-down list, and leave the default value in the End field to use all remaining disk space. Select **/var** from the Mount Point drop-down list. Click **OK** to continue.

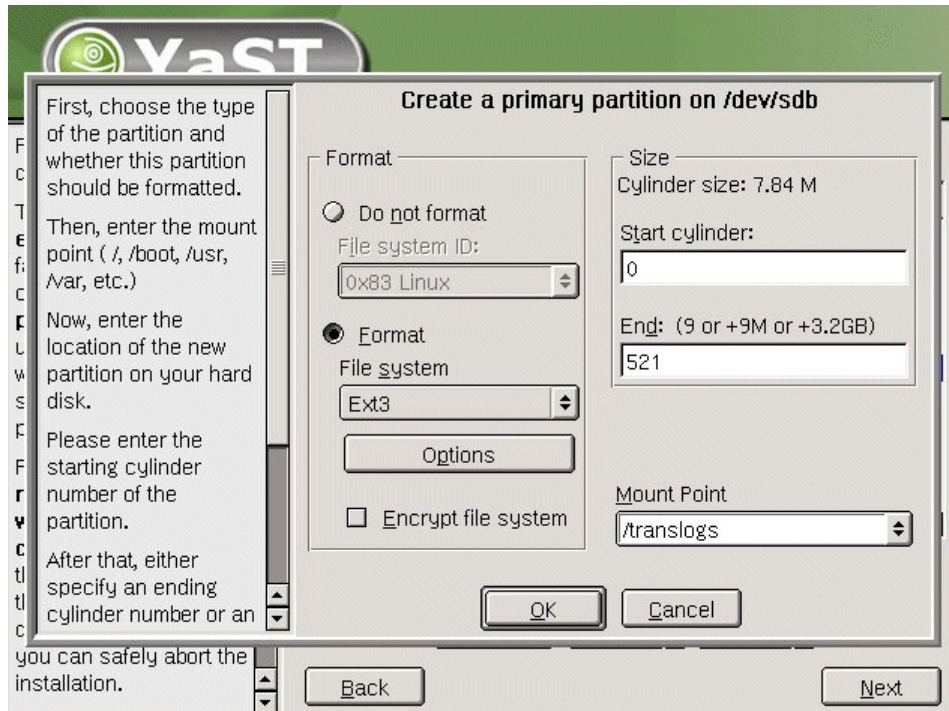


Figure 1-47 SuSE 8.0 - Creation of the transaction logs

16. Click **Create** and select the next available array (sdb for our installation), then select **Primary**. (This is the same procedure described in steps 7 and 8.)

Next, fill in the necessary information. Click **Format**, select **Ext3** from the File system drop-down list, use all disk space (which is the default), and type /translogs in the Mount Point field. This will create a partition specifically for the Domino Transaction Logs. Click **OK** to continue.

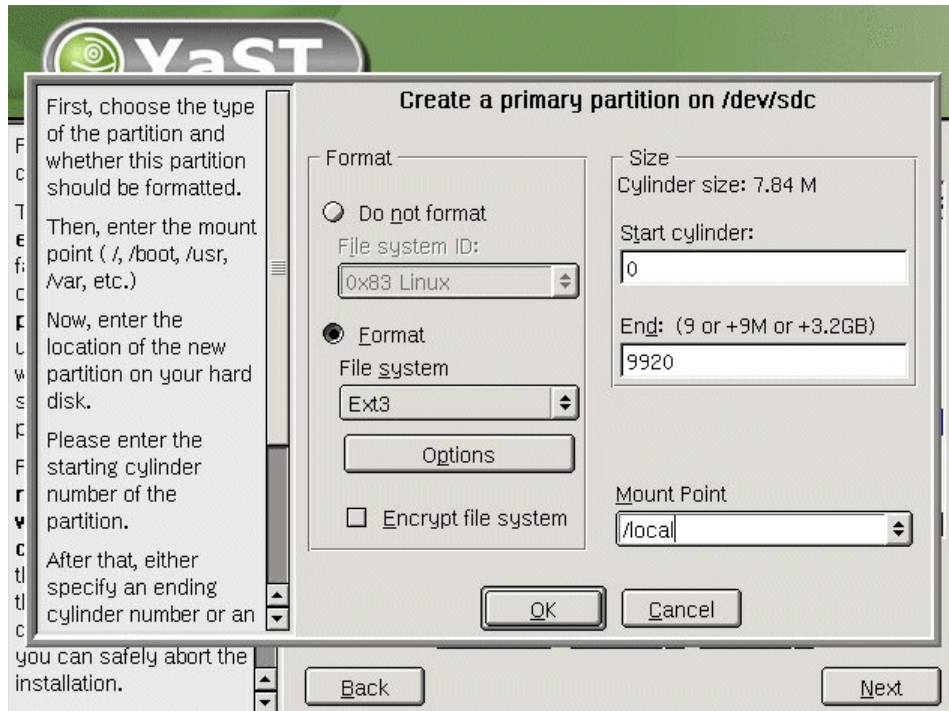


Figure 1-48 SuSE 8.0:- Creation of the /local partition

17. Click **Create** and select the next available array (sdc for our installation), then select **Primary**. (This is the same procedure described in steps 7 and 8, and also in step 16.)

Once again, complete the necessary information. Click **Format**, select **Ext3** from the File system drop-down list, use all disk space (which is the default), and type /local in the Mount Point field. This will create a partition specifically for your Domino data. Click **OK** to continue.

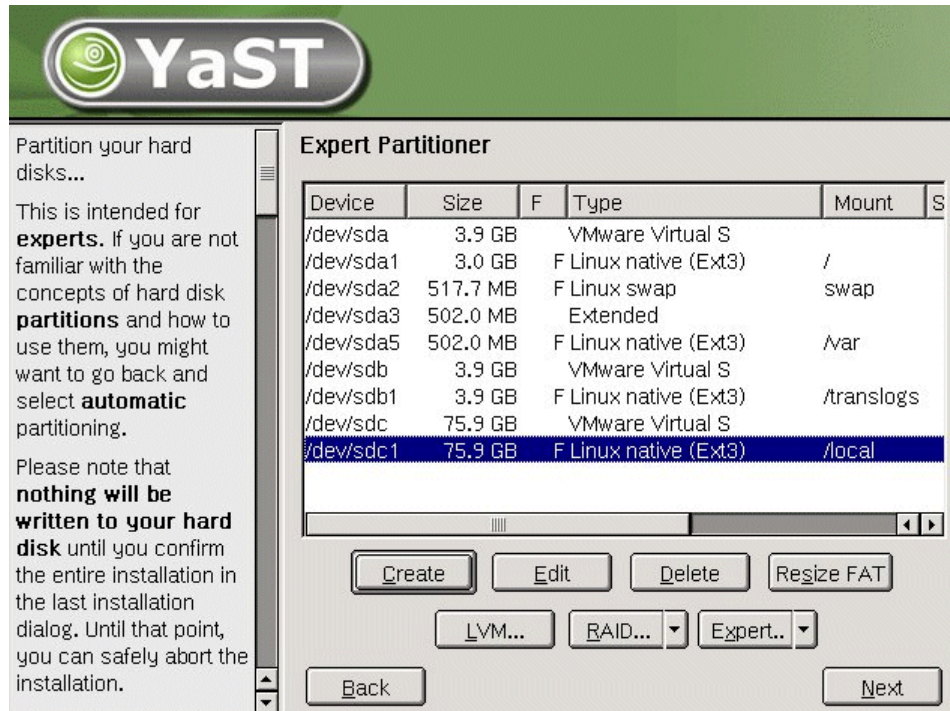


Figure 1-49 SuSE 8.0: Final partition list

18. Figure 1-49 shows the final partition list. Click **Next** to continue. The partitions will not be written to disk until you reach the end of the setup.



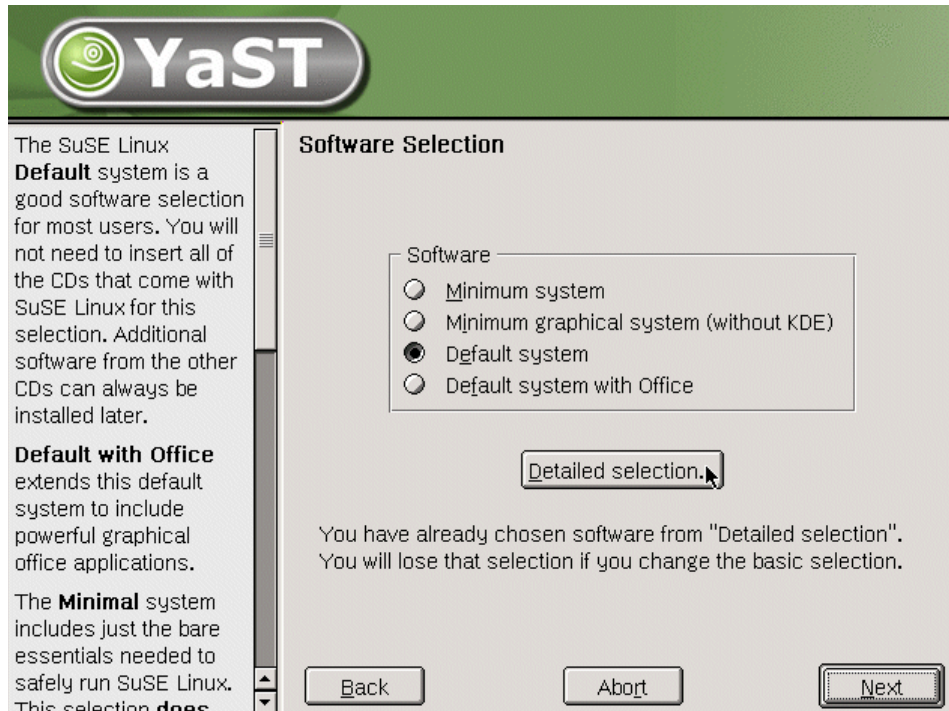


Figure 1-50 SuSE 8.0: Software selection

19. Select **Default System**, and click **Detailed Selection** as shown in Figure 1-50.

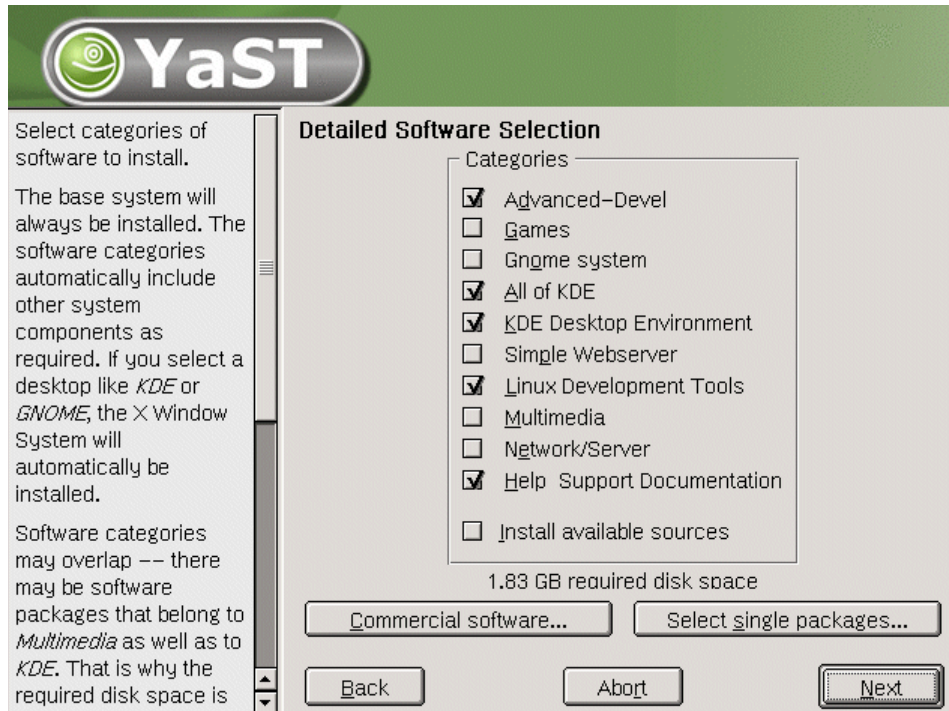


Figure 1-51 SuSE 8.0: Detailed software selection

20. Figure 1-51 shows the screen used to make your detailed software selections. If a box has a check mark, the package is selected for installation; if it is blank, it will not be installed. We recommend that you select the same packages for your installation as we did. The software we selected is:

- Advanced-Devel
- All of KDE
- KDE Desktop Environment
- Linux Development Tools
- Help Support Documentation

Click **Select single packages** to add ftp and telnet.

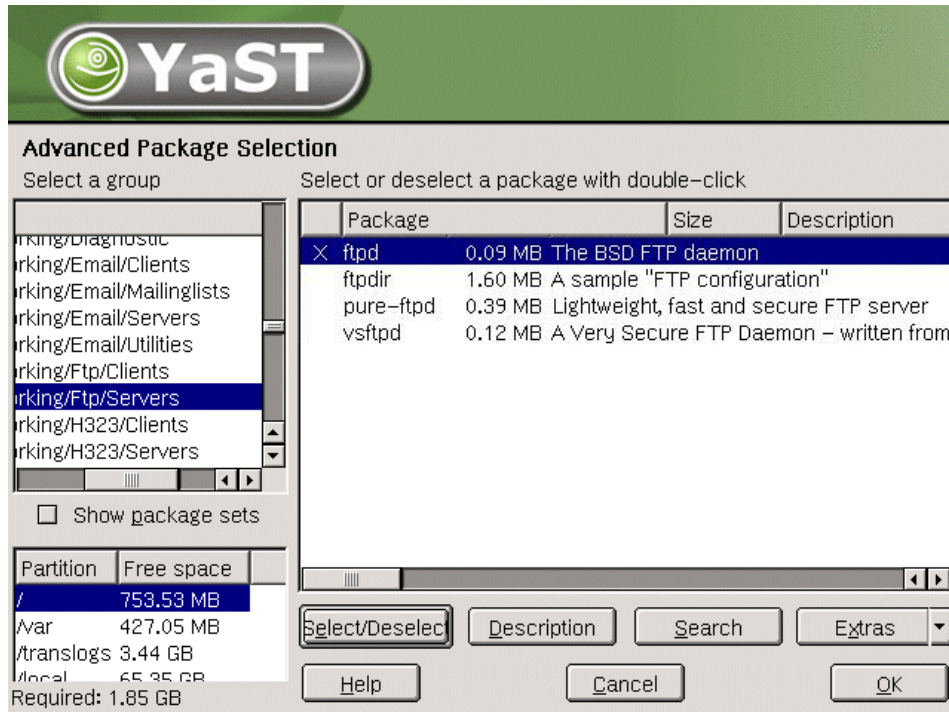


Figure 1-52 SuSE 8.0: Adding the FTP package

21. Select **Networking/Ftp/Servers**, click **ftpd**, then click **Select/Deselect** to add the FTP daemon. FTP provides an easy method by which to transfer files.

**Attention:** SSH can provide file transfer via scp, as well as a secure telnet-like connection. If you are going to set up SSH, or already have it deployed in your environment, you will not need ftp or telnet.



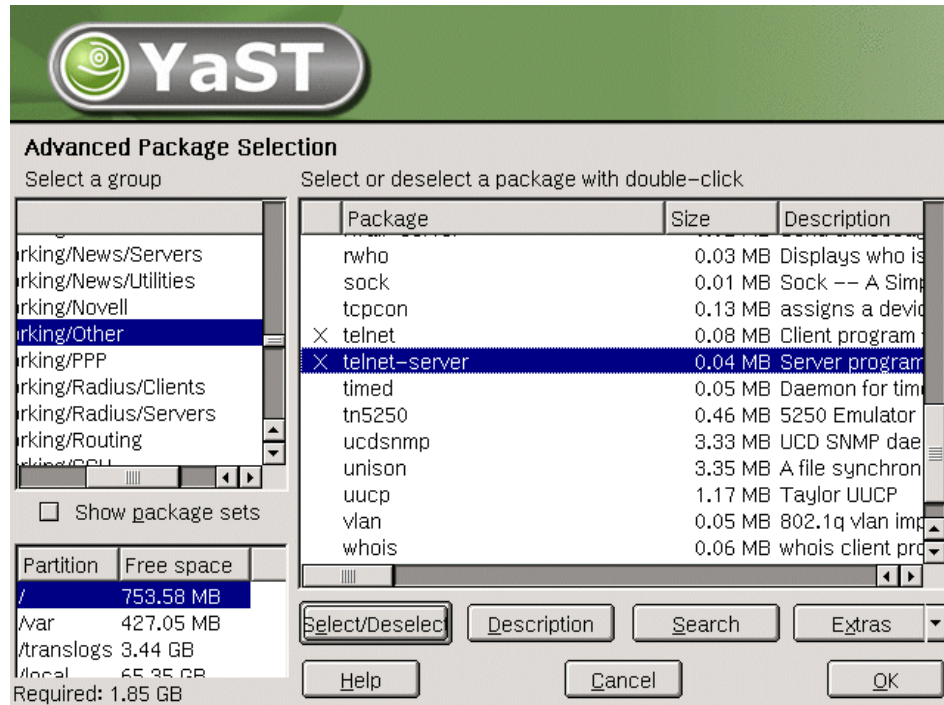


Figure 1-53 SuSE 8.0: Adding the telnet package

22. Select **Networking/Other**, click **telnet-server**, then click **Select/Deselect** to add the telnet daemon. Telnet provides an easy method by which to connect to a server. (As already noted, SSH securely provides the same connectivity.) Then click **OK**.

**Tip:** Take a moment to scroll through the selections and see if there are any other programs you would like to install. You can always add packages later with YaST2 (Yet another Setup Tool).

**Note:** Some packages require configuration before they can be used.

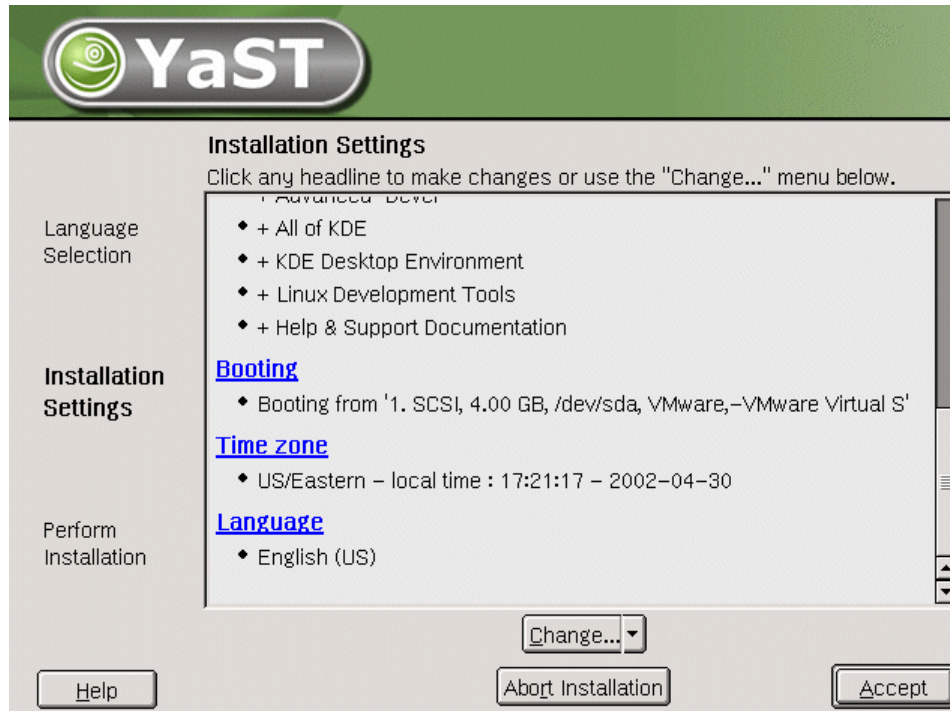


Figure 1-54 SuSE 8.0: Time zone

23. Use the scroll bar on the side to scroll through the installation setting; click **Time Zone** to change your time zone settings.

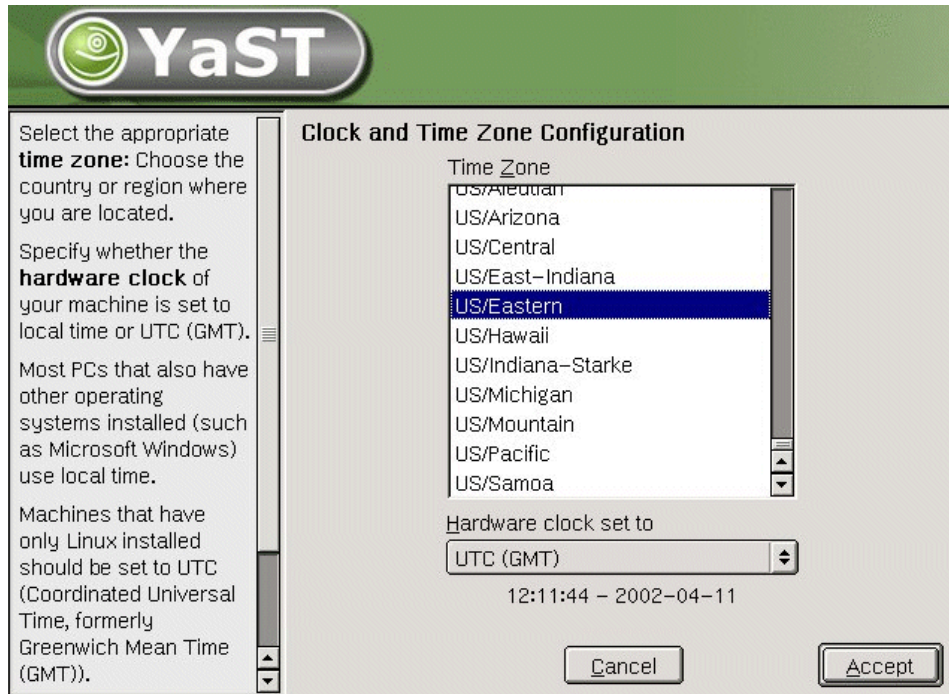


Figure 1-55 SuSE 8.0 - Time Zone selection

24. Use the scroll bar to scroll through the Time Zone list. Click your time zone and ensure that you have selected the correct Hardware Clock setting. Click **Accept** to return to the Installation Settings screen.

**Tip:** For countries with Daylight Saving, we recommend that you set the BIOS clock to GMT and select **Hardware clock set to UTC (GMT)**.

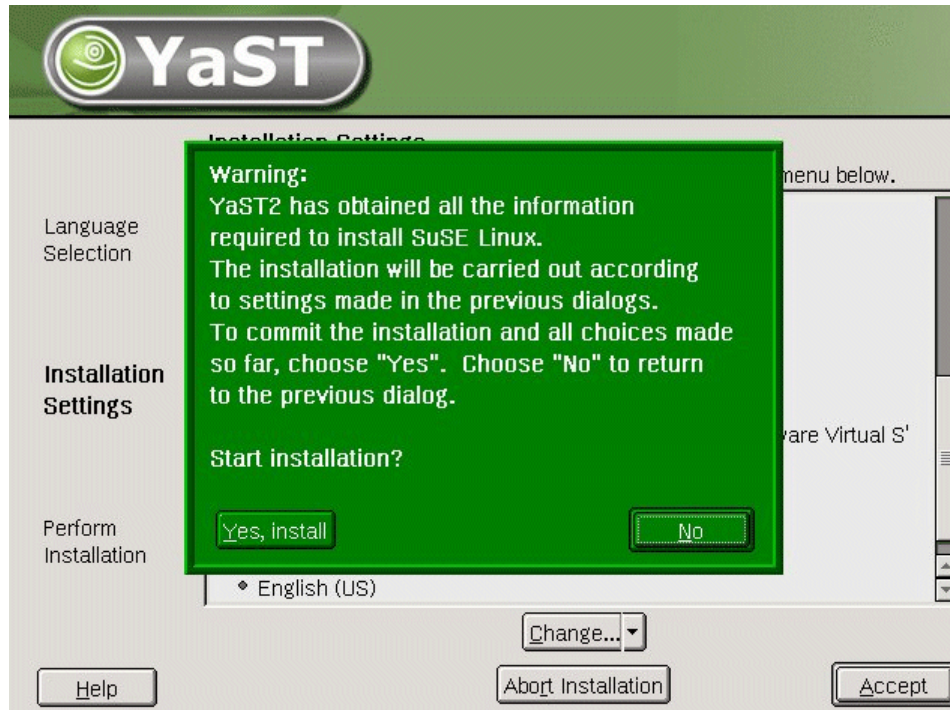


Figure 1-56 Suse 8.0 - Ready to start installation

25. Once all settings are correct, you can proceed with the installation. Click **Accept** to start the install.

You will be prompted to confirm that the installation can be done. Click **Yes** to proceed with the installation as shown in Figure 1-56.

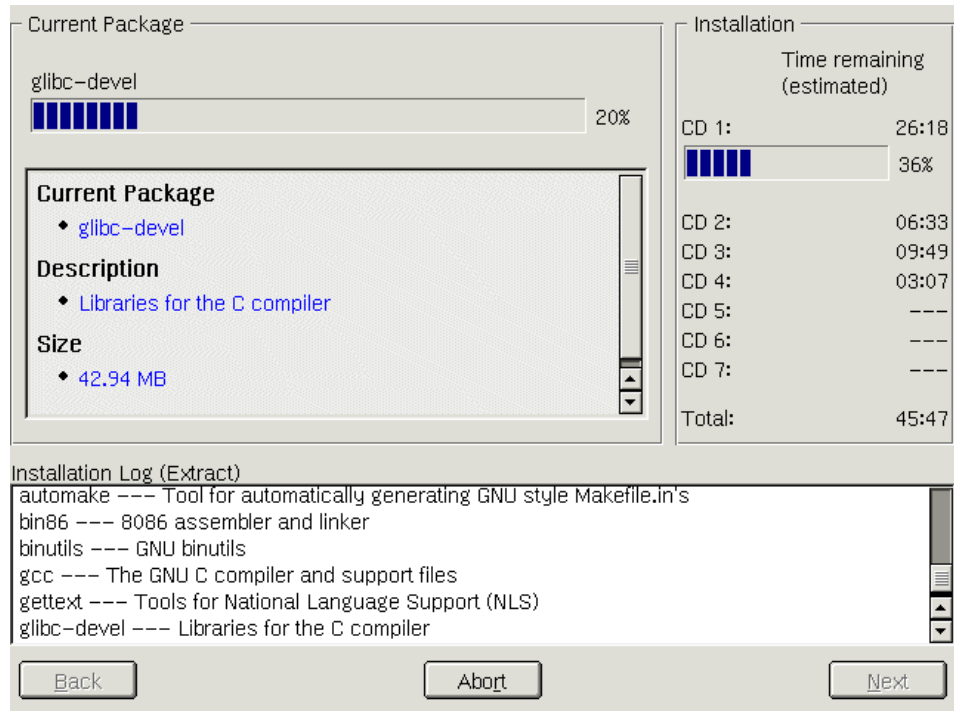


Figure 1-57 SuSE 8.0: Package installation

26. You will see several screens as your partitions are formatted, then the actual installation starts. The package names are displayed as they are installed. As each package installation finishes, a line is added to the Installation Log window shown in Figure 1-57.

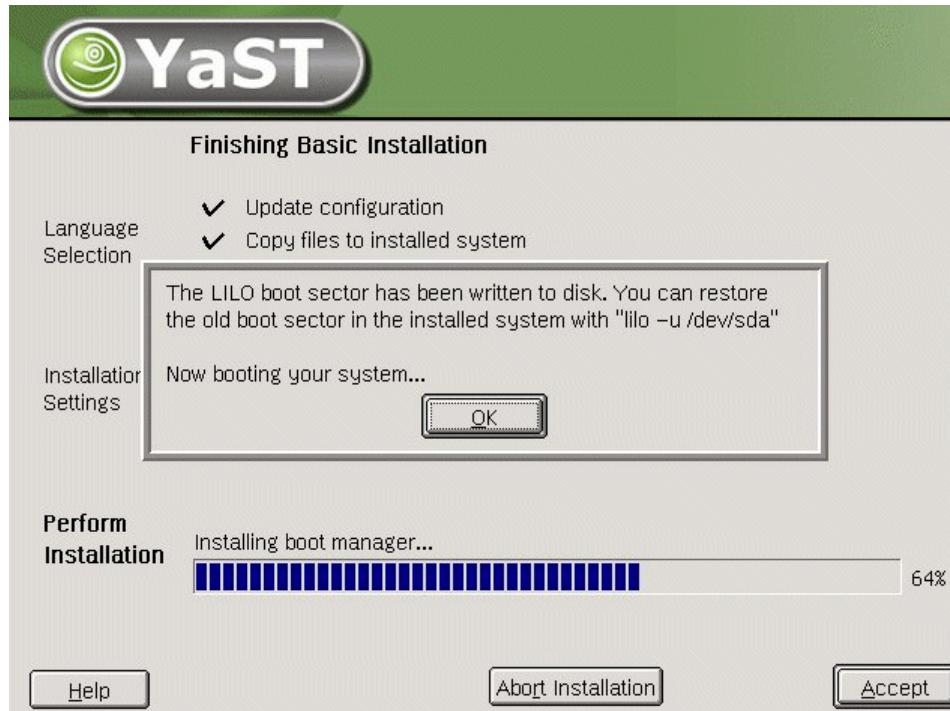


Figure 1-58 SuSE 8.0: Finishing basic installation

27. Once the basic installation is complete, several tasks are performed. These can be seen in the background of Figure 1-58.

Partway through these tasks, the message shown in the foreground of Figure 1-58 will be displayed, stating that the LILO Boot sector has been written. LILO is the boot manager used by most Linux distributions. The boot manager is the same as the NTLDR on a Windows NT/2000 machine, but it is a lot more powerful than the Microsoft equivalent. Click **OK** to continue with the installation.



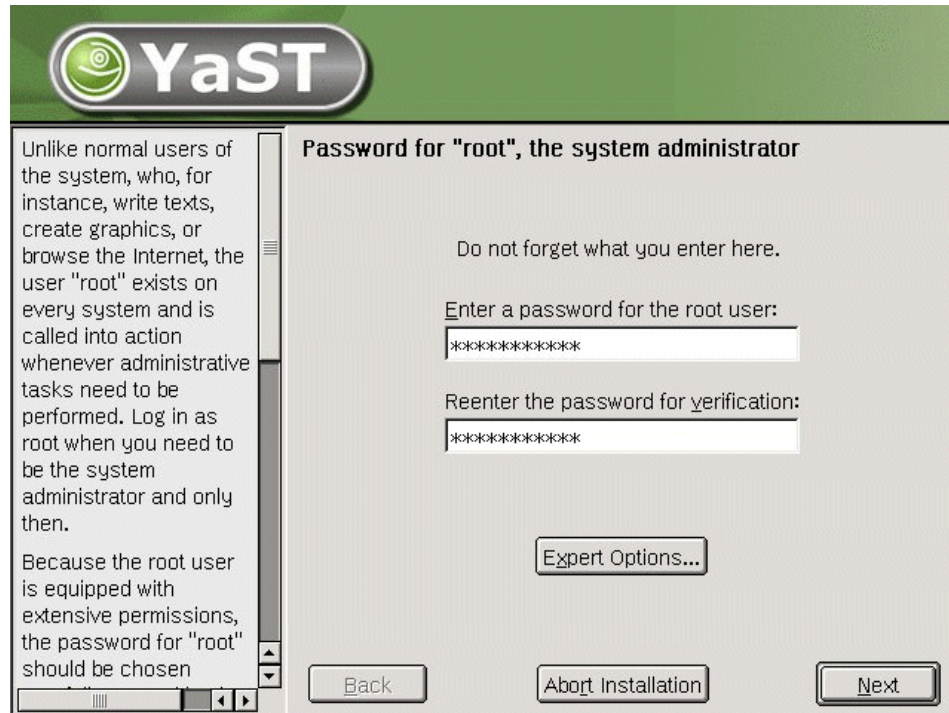


Figure 1-59 SuSE 8.0: System administrator password

28. The screen will switch to text mode and several lines will scroll across it as subsystems are started. If the next CD is required, you will be prompted to insert it. Click **OK** once the correct CD is loaded. Repeat this process for all remaining CDs.

Next, you will be prompted for the system administrator (root) password as shown in Figure 1-59. Enter the password you want to set for user root. The root user is also known as the *Super User*, and is equivalent to the NT Administrator account. This account has full control over the system.

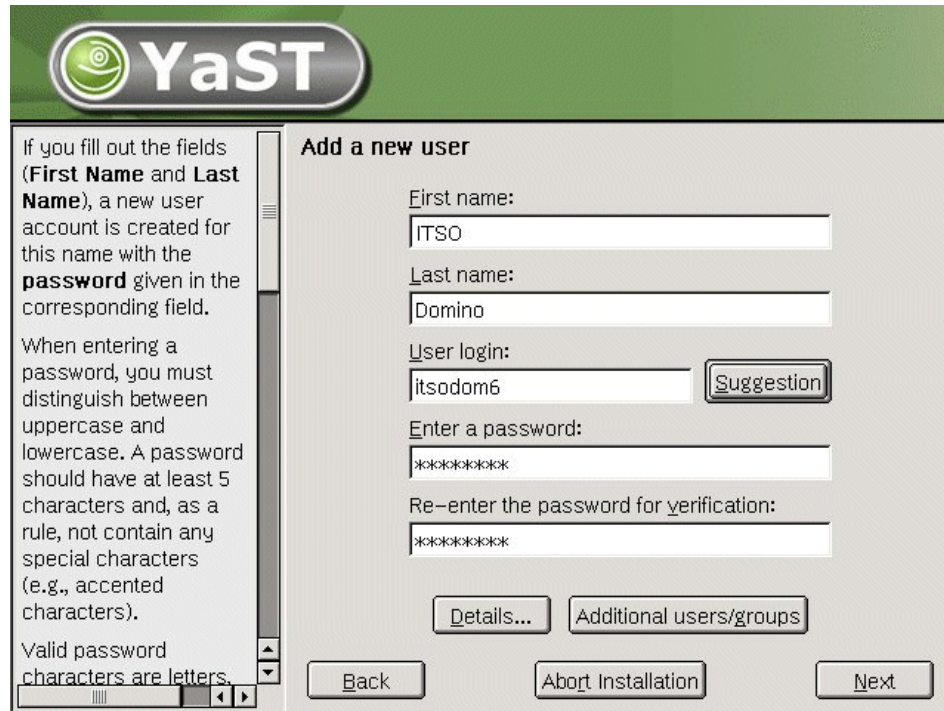
Enter the password, then click **Expert Options** to change security settings.



Figure 1-60 SuSE 8.0 - MD5 password option

29. Select **MD5** for Password Encryption, click **OK**, then click **Next**.





**YaST**

If you fill out the fields (**First Name** and **Last Name**), a new user account is created for this name with the **password** given in the corresponding field.

When entering a password, you must distinguish between uppercase and lowercase. A password should have at least 5 characters and, as a rule, not contain any special characters (e.g., accented characters).

Valid password characters are letters.

### Add a new user

First name:

Last name:

User login:

Enter a password:

Re-enter the password for verification:

Figure 1-61 SuSE 8.0 - Add a new user

30. Add a Domino user to the system. Once you have entered all the required information, click **Next** to continue.

**Tip:** After filling in the requisite information, you can click the **Additional users/groups** button. Click the **Group** tab, create a group called notes, and add the user account you just created (itsodom6 in our case) to the notes group. This will ensure that your user and group are ready for the Domino 6 installation.

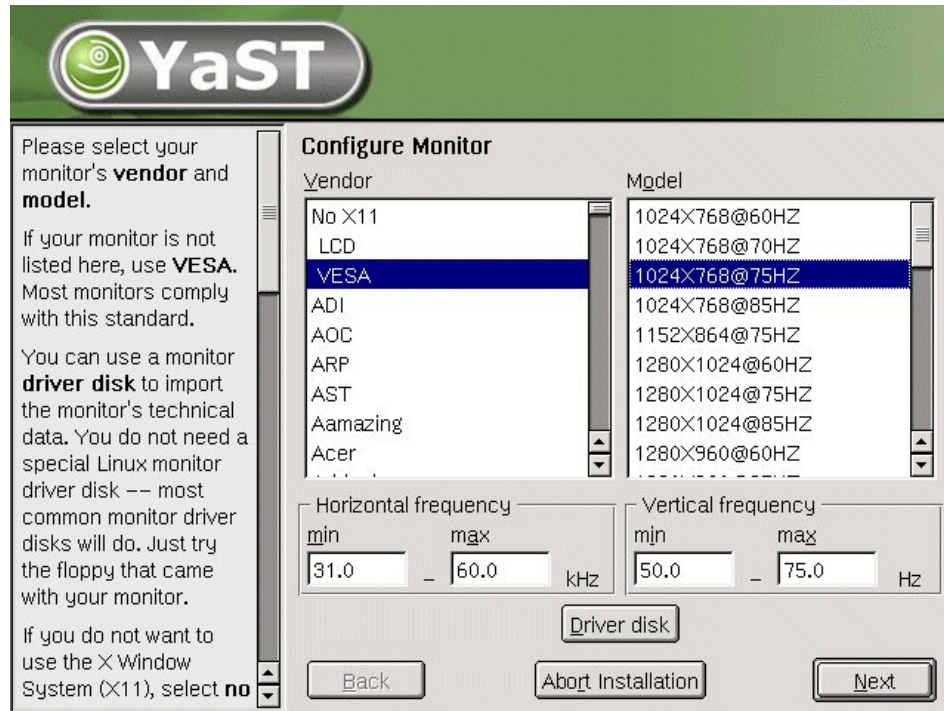


Figure 1-62 SuSE 8.0: Configure monitor

31. On the next few screens your monitor and video card will be configured. As shown in Figure 1-62, the installer tries to determine which monitor you have attached to your system.

If the installer was not able to determine your monitor, you can select it from the list of monitors. If you have the monitor driver disk that came with your monitor, you can insert that and let the installation program read the settings from the diskette. Click **Driver disk** to make use of this feature.

If your monitor is not listed, use VESA since most monitors comply with this standard.

Once your selection is made, click **Next** to Proceed.

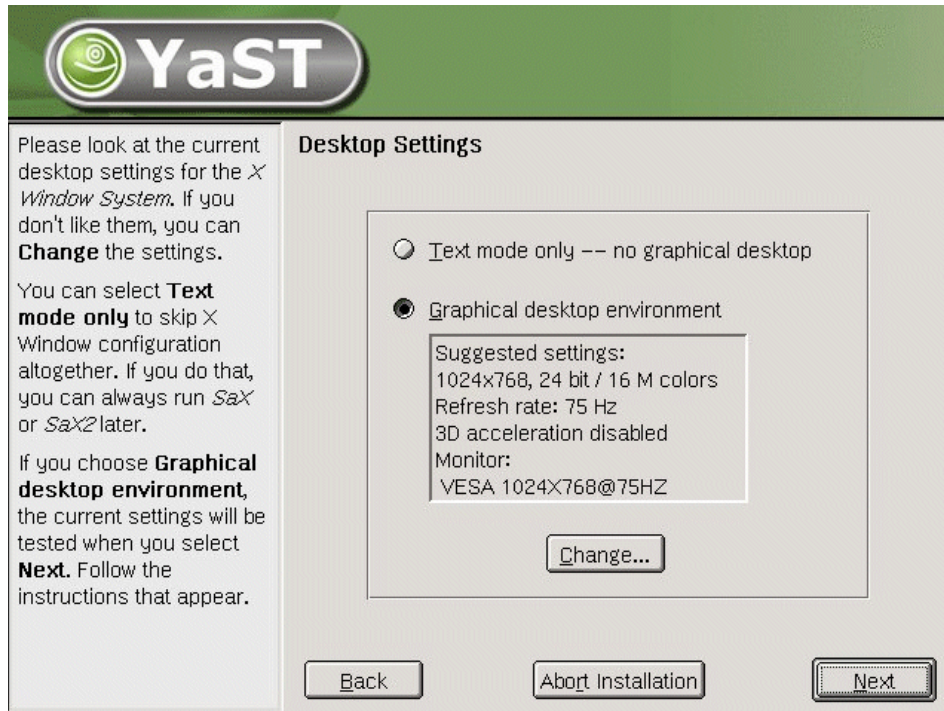


Figure 1-63 SuSE 8.0: Desktop settings

32. The screen shown in Figure 1-63 is displayed if the video card in your machine and its capabilities could be determined. If the settings are incorrect, click **Change**. Pick a resolution that is as high as your monitor can display or that is comfortable for you. Linux displays are quite big and so work better at 1024x768 or higher resolutions.

Click **Next** to continue. This will automatically test your settings.

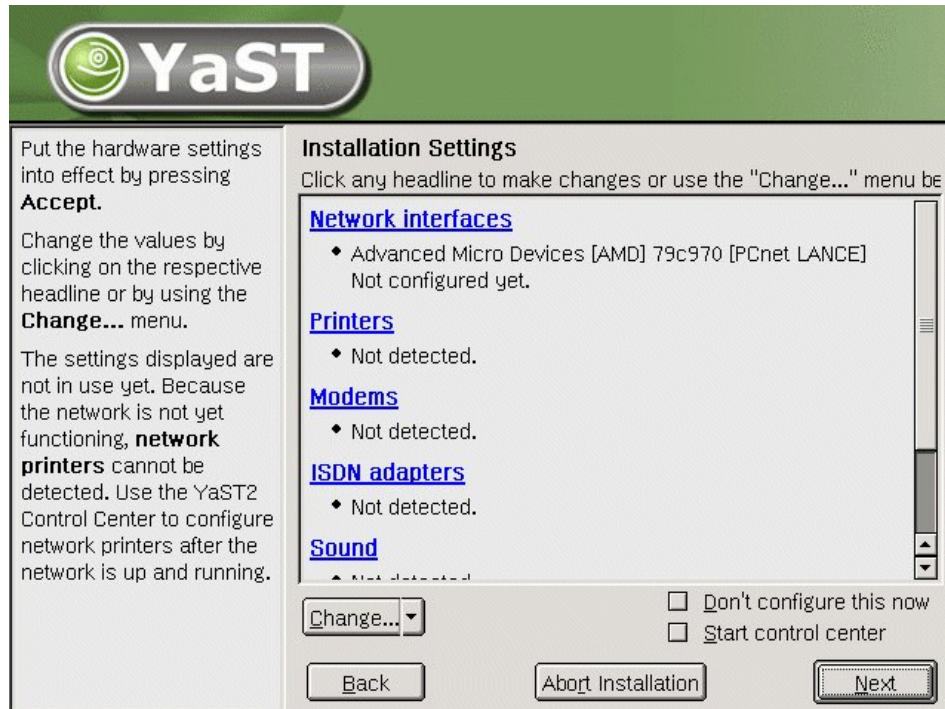


Figure 1-64 SuSE 8.0: Installation settings

33. The Installation Settings screen shown in Figure 1-64 will be displayed. Here you can configure various peripherals, such as Networking, Printers, Modems, and so forth.

You need to configure your network interface. Click **Network interfaces** to change its settings.



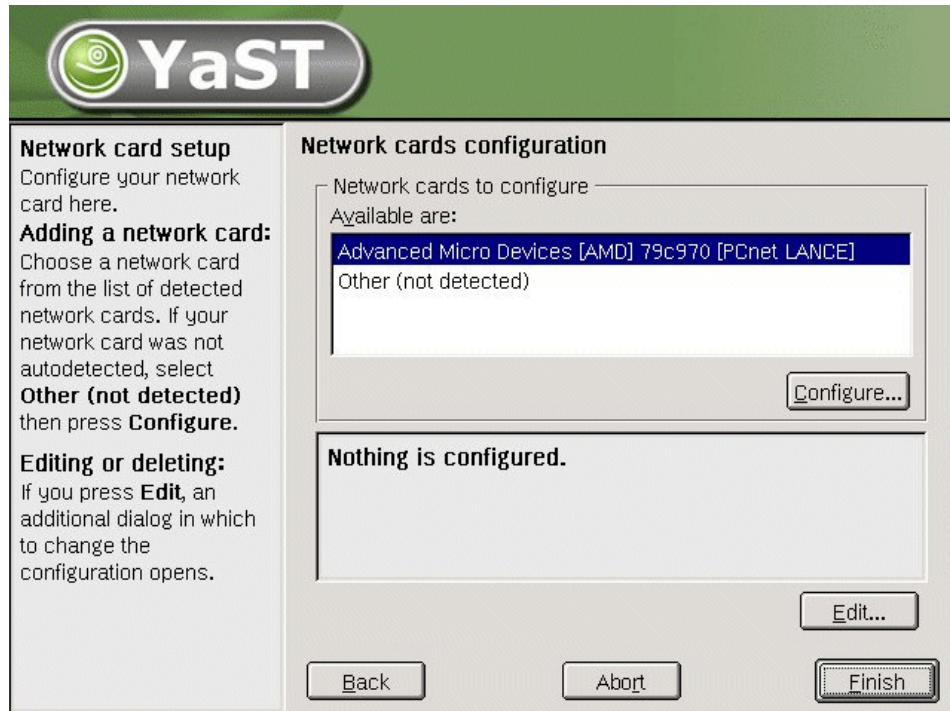


Figure 1-65 SuSE 8.0: Network cards configuration

34. A list of detected network cards installed in your system will be displayed as shown in Figure 1-65. Click the name of the network card you would like to configure, then click **Configure**.

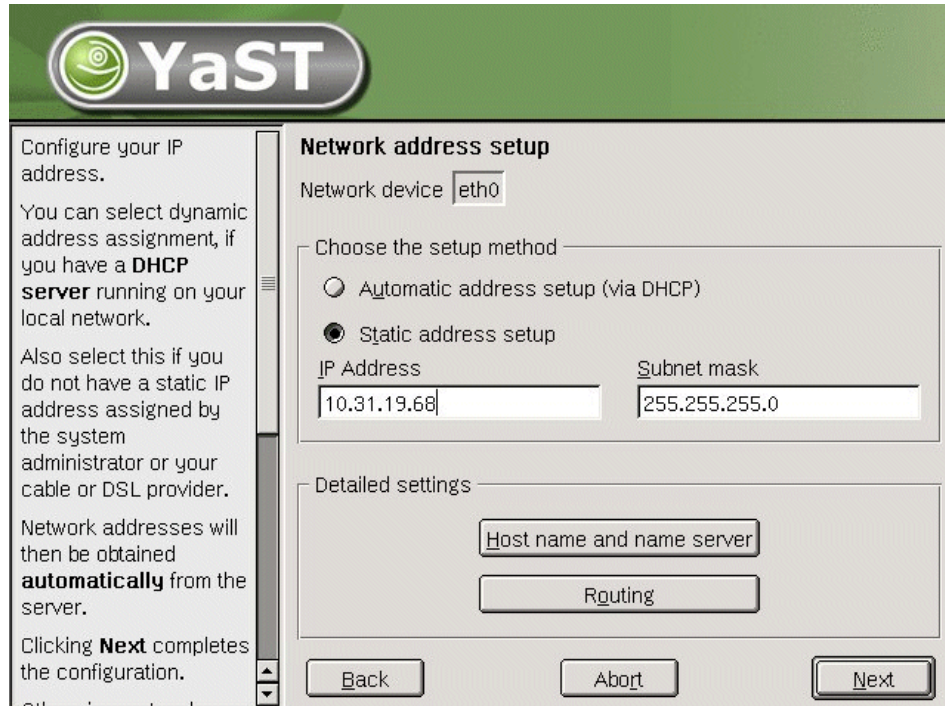



Figure 1-66 SuSE 8.0: Network address setup

35. Change to **Static address setup** and enter the IP Address and Subnet Mask in the fields provided. Once your settings are correct, click the **Host name and name server** button.



Insert the host name and domain name for your computer. Name server list and domain search list are optional.

A name server is a computer that translates host names into IP addresses. This value must be entered as an **IP address** (e.g., 10.10.0.1), not as a host name.

Search domain is the domain name where host name searching starts. The primary search domain is usually the same as the **domain name** of your computer (e.g.,

### Host name and name server configuration

Host name and domain name

Host name	Domain name
itsosuse	lotus.com

☐ Change host name via DHCP

Name server list	Domain search list
10.31.19.1	
10.31.19.2	

Back Abort Next

Figure 1-67 SuSE 8.0 - Host name and name server configuration

36. Enter the Host name and Domain Name of your system, the Name Server IP Addresses, and any additional domains to search in the Domain Search List. Click **Next** to return to the Network Address Setup screen.

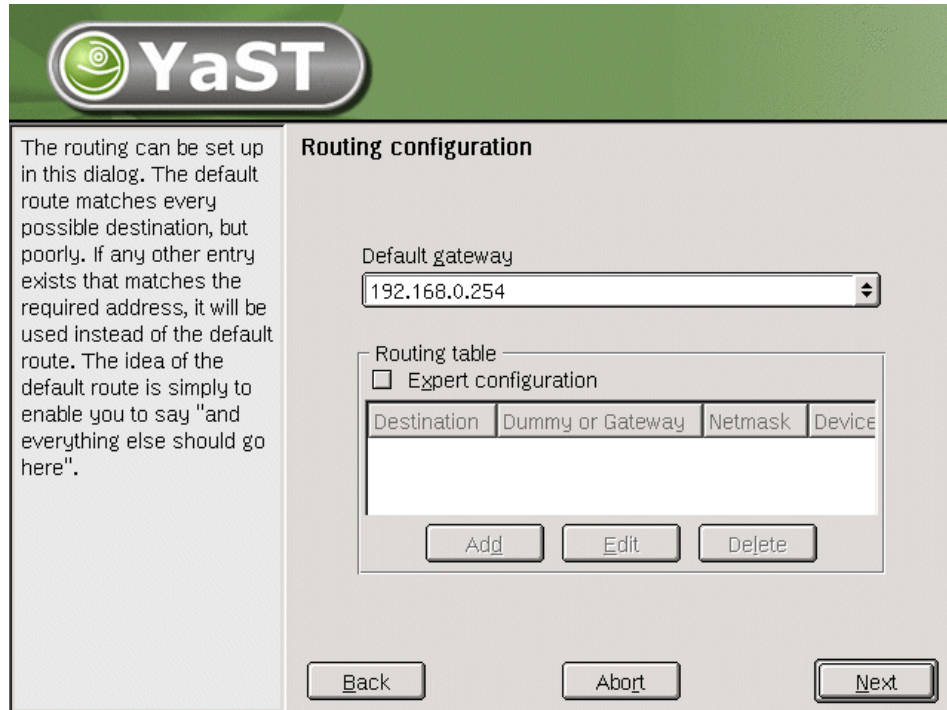


Figure 1-68 SuSE 8.0: Routing configuration

37. Before you configure another card, click the **Routing** button shown back in Figure 1-66 on page 76 and enter the default gateway for your network as shown in Figure 1-68. Click **Next**, then **Next** again to return to the Network Card Configuration screen shown in Figure 1-69 on page 79.



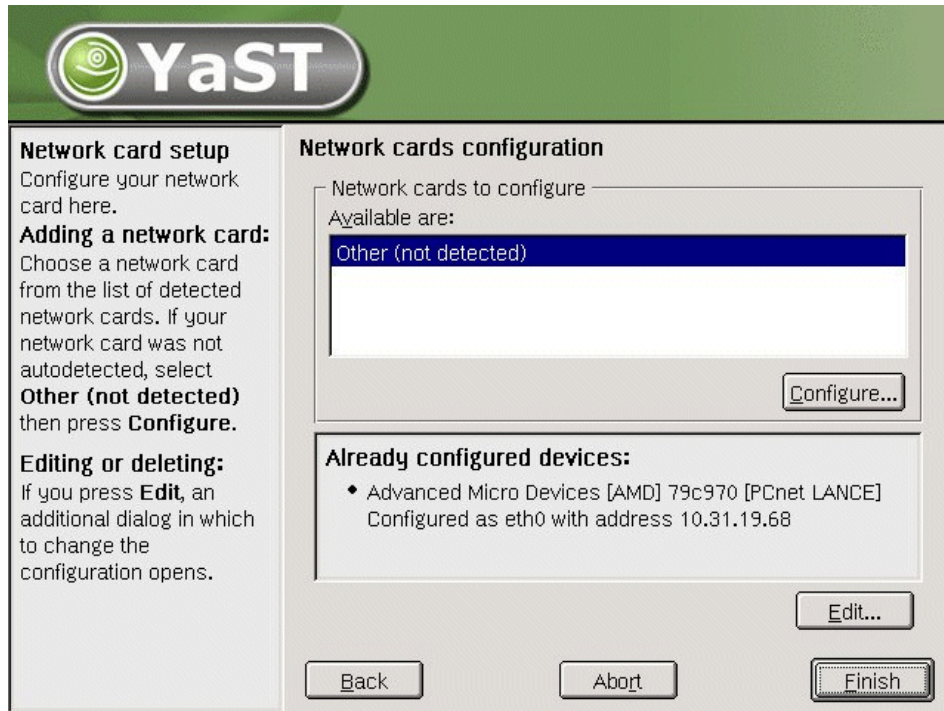
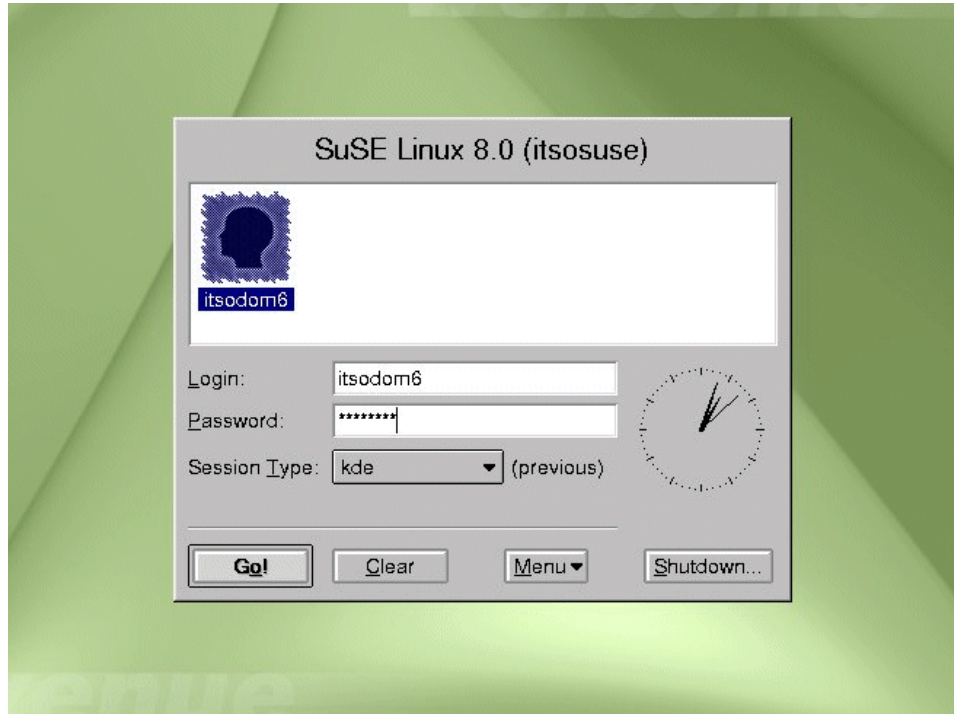


Figure 1-69 SuSE 8.0: Network card configured

You can repeat these steps to configure additional network cards installed in your system. Click **Finish** to return to the Installation Settings.

You can configure the other peripherals listed in Figure 1-64 on page 74.

For the purpose of these instructions we continue with the installation by clicking **Next**.



*Figure 1-70 SuSE 8.0: Graphical log in*

38. The configuration of your system is written to disk. A window will appear to inform you that the configuration has been saved successfully. Let it time out to start up the system. Several lines of text will scroll across your monitor as the system is started.

Once the system has loaded, you are ready to log in with the account you created during installation, as shown in Figure 1-70.

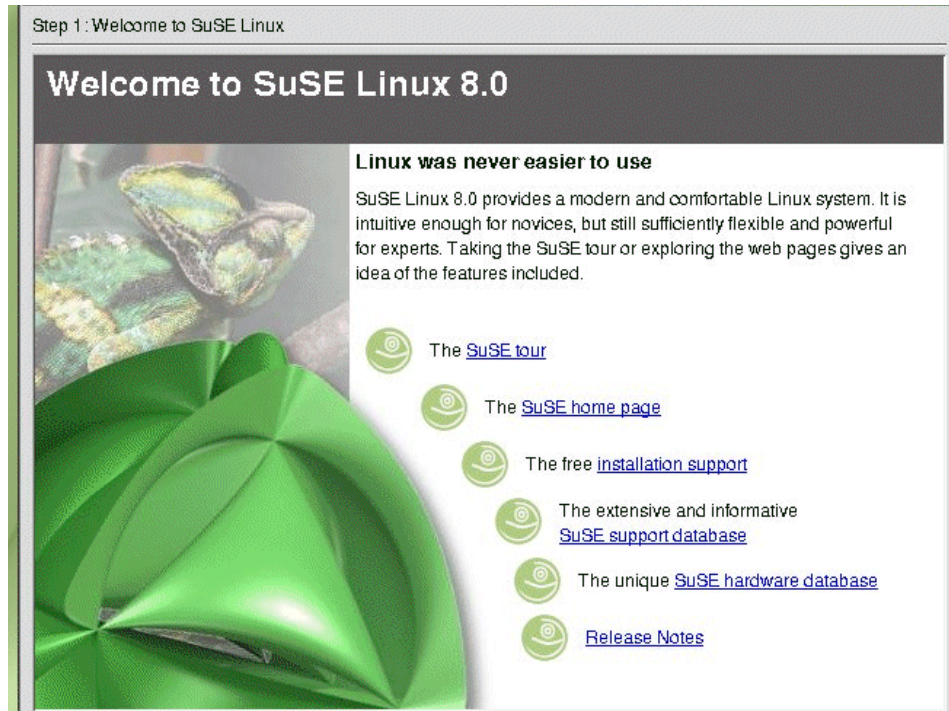


Figure 1-71 SuSE 8.0: Welcome screen

39. KDE will load, and then you will see the desktop settings wizard shown in Figure 1-71. Click **Next** to accept the default settings, then click **Finish** to close the wizard.

This completes the SuSE 8.0 installation process.





# Installing Domino 6 for Linux

In this chapter, we show how to check that your Linux system is properly configured for Domino, then we describe how to install, set up, and launch the Domino server. Along the way, we provide tips for how to make your environment more user-friendly. For a discussion of security, see Chapter 3, “Security and administration” on page 133; for performance, see Chapter 4, “Performance, scalability, and troubleshooting” on page 195.

## 2.1 Before you begin: Pre-installation tasks

First off, you need to make certain you have a Linux user account, as well as a group, under which to run Domino. After booting the system, enter root for the username, then the root password you entered during installation. Depending on whether you elected to have X-Windows launch automatically, you will be at the command line prompt or an X-Windows prompt. From the command line, log in as root then type `startx` to begin an X-Windows session. Otherwise, log in as root and the graphical desktop environment of your choice will load—ours is KDE.

The bottom of a typical KDE or GNOME desktop has a task bar. Locate the shell icon, which in KDE is a monitor with a sea shell superimposed, and click the icon *once*.

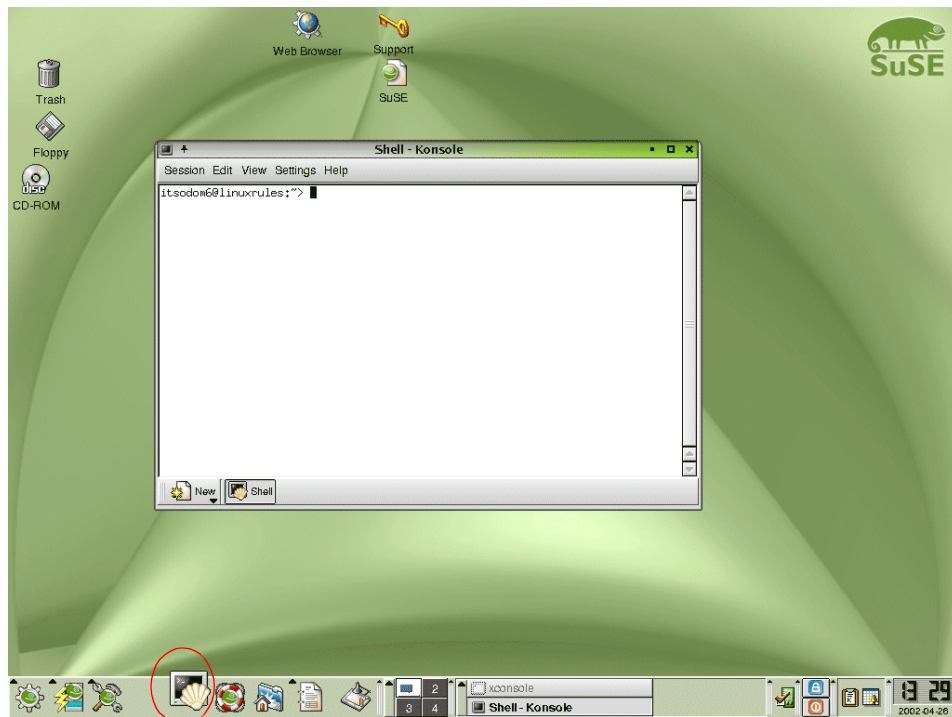
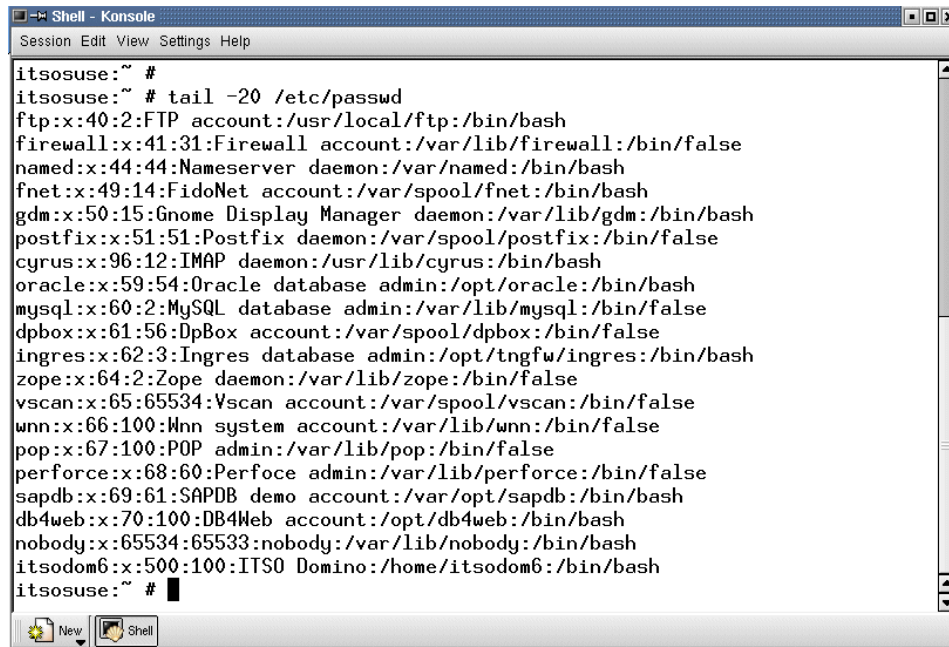


Figure 2-1 The Shell Konsole in KDE

**Tip:** If you are accustomed to double-clicking icons in order to launch applications, you can change the default behavior of KDE via the Control Center. Click the **Start Applications** icon (first icon starting from the left of the task bar), click **Control Center**, and go to **Peripherals -> Mouse**.

1. Check that the “notes” account exists.

Once you have the shell running, you can check for the existence of the notes account. One way to check is shown in Figure 2-2. The `tail` command shows you the last *x* number of lines for a file as specified by the command line parameter. We used `tail -20 /etc/passwd` to view the last 20 lines of the `passwd` file. The names of user accounts are kept in this file and located in the first position of each line; you can see our account, *itsodome6*, listed at the very bottom.



```
itsosuse:~ #  
itsosuse:~ # tail -20 /etc/passwd  
ftp:x:40:2:FTP account:/usr/local/ftp:/bin/bash  
firewall:x:41:31:Firewall account:/var/lib/firewall:/bin/false  
named:x:44:44:Nameserver daemon:/var/named:/bin/bash  
fnet:x:49:14:FidoNet account:/var/spool/fnet:/bin/bash  
gdm:x:50:15:Gnome Display Manager daemon:/var/lib/gdm:/bin/bash  
postfix:x:51:51:Postfix daemon:/var/spool/postfix:/bin/false  
cyrus:x:96:12:IMAP daemon:/usr/lib/cyrus:/bin/bash  
oracle:x:59:54:Oracle database admin:/opt/oracle:/bin/bash  
mysql:x:60:2:MySQL database admin:/var/lib/mysql:/bin/false  
dpbox:x:61:56:DpBox account:/var/spool/dpbox:/bin/false  
ingres:x:62:3:Ingres database admin:/opt/tngfw/ingres:/bin/bash  
zope:x:64:2:Zope daemon:/var/lib/zope:/bin/false  
vscan:x:65:65534:Vscan account:/var/spool/vscan:/bin/false  
wnn:x:66:100:Wnn system account:/var/lib/wnn:/bin/false  
pop:x:67:100:POP admin:/var/lib/pop:/bin/false  
perforce:x:68:60:Perforce admin:/var/lib/perforce:/bin/false  
sapdb:x:69:61:SAPDB demo account:/var/opt/sapdb:/bin/bash  
db4web:x:70:100:DB4Web account:/opt/db4web:/bin/bash  
nobody:x:65534:65533:nobody:/var/lib/nobody:/bin/bash  
itsodome6:x:500:100:ITS0 Domino:/home/itsodome6:/bin/bash  
itsosuse:~ #
```

Figure 2-2 Portion of the `passwd` file

Those new to Linux will notice quite a few differences. Unlike a graphical user interface, the command line interface allows you to work “more closely” with the system. In addition to seeing the data, you see exactly how it is structured. While it is both a strength and a weakness of the command line that it lacks the ease of a GUI, the beauty of Linux is that you get the best of both: you can

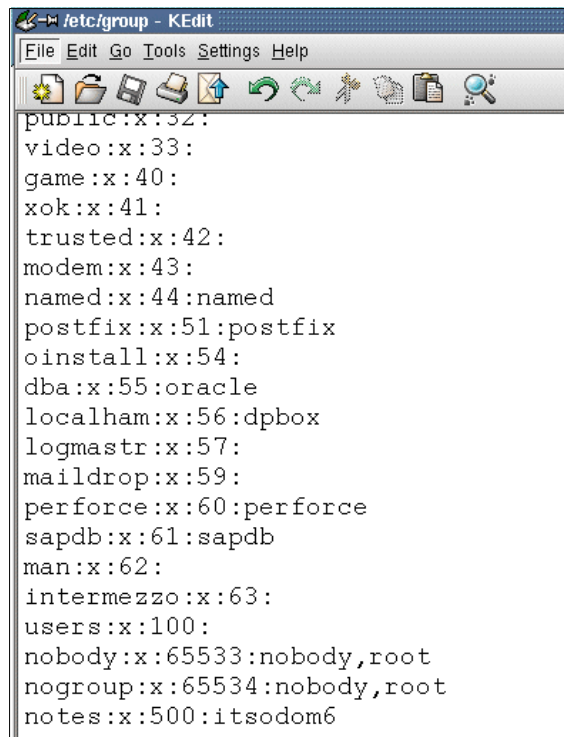


use the command line when you wish and otherwise use the numerous GUI programs available in a graphical desktop environment, such as KDE.

2. Check that the user group for Domino exists.

Next, we need to ensure that we created a user group for Domino and that our account, itsodom6, is a member of that group. Those familiar with Lotus Notes will understand the use of users and groups. The main difference is that in Linux you cannot nest a group within another group.

To check for the group, we launch KATE by navigating to **Start Application -> Office -> Editors -> KATE** (SuSE) or **Start Application -> Editors -> KATE** (RedHat). KATE is a simple GUI text editor suitable for use in viewing the `/etc/group` file. You can see that the group, *notes*, is listed at the bottom and that our itsodom6 account is a member.



```
/etc/group - KEdit
File Edit Go Tools Settings Help
public:x:32:
video:x:33:
game:x:40:
xok:x:41:
trusted:x:42:
modem:x:43:
named:x:44:named
postfix:x:51:postfix
oinstall:x:54:
dba:x:55:oracle
localham:x:56:dpbox
logmastr:x:57:
maildrop:x:59:
perforce:x:60:perforce
sapdb:x:61:sapdb
man:x:62:
intermezzo:x:63:
users:x:100:
nobody:x:65533:nobody,root
nogroup:x:65534:nobody,root
notes:x:500:itsodom6
```

Figure 2-3 The contents of the `/etc/group` file.

If you look at the user file, you will notice the number *500* on the itsodom6 line and again on the notes group line. Just as DNS is a human-friendly version of numerical IPs, Linux associates the names of users and groups with unique numbers so we can refer to them by name instead of number.



In our example, we created the appropriate user account and group during installation. If you did so as well, you can skip ahead to Step 6 on page 89.

### 3. Create the Linux user group to run Domino.

If the user and group do not exist, you need to launch a user manager program. From the command line, you can run **useradd**, **userdel**, or **usermod** and **groupadd**, **groupdel**, or **groupmod**, depending on whether you want to add, delete, or modify a user or group. With a graphical desktop environment, you have the use **Red Hat User Manager** and SuSE's **YAST2**, as well as **KDE User Manager**.

We used *KDE User Manager* because it is easy to use and is common to both distributions. From KDE for Red Hat 7.2, navigate to **Start Application -> System -> User Manager**; from SuSE 8.0 navigate to **Start Application -> System -> Configuration -> KUser**. The Start Application button is the far left button on the KDE task bar (refer to Figure 2-1 on page 84 for a view of the KDE desktop).

First, create the notes group before adding the user. This makes the notes group an available selection for the user account you will create next.

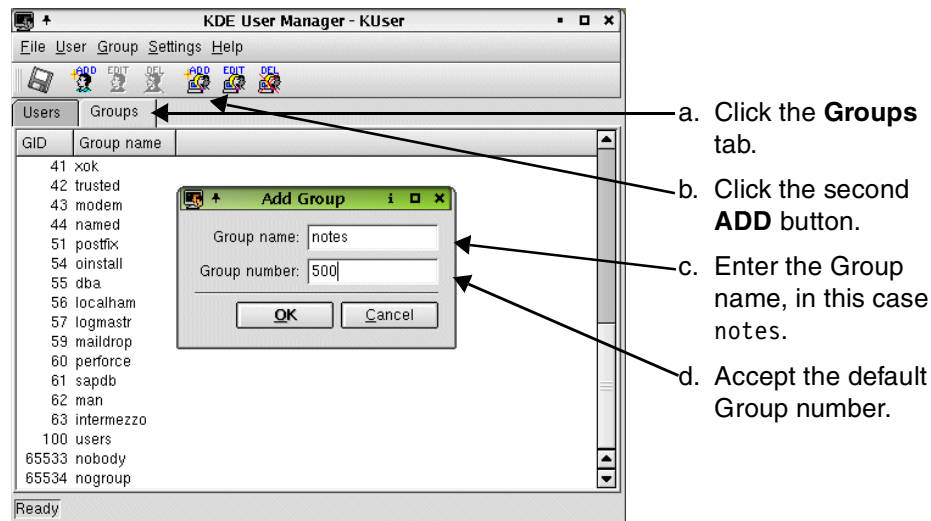


Figure 2-4 Add Group with KDE User Manager

### 4. Create a Linux user account to run Domino.

Now that you have created the group, you can switch back to the **Users** tab to create the account that will run the Domino server. When you click the first **ADD** button, you will be prompted to enter the Username.

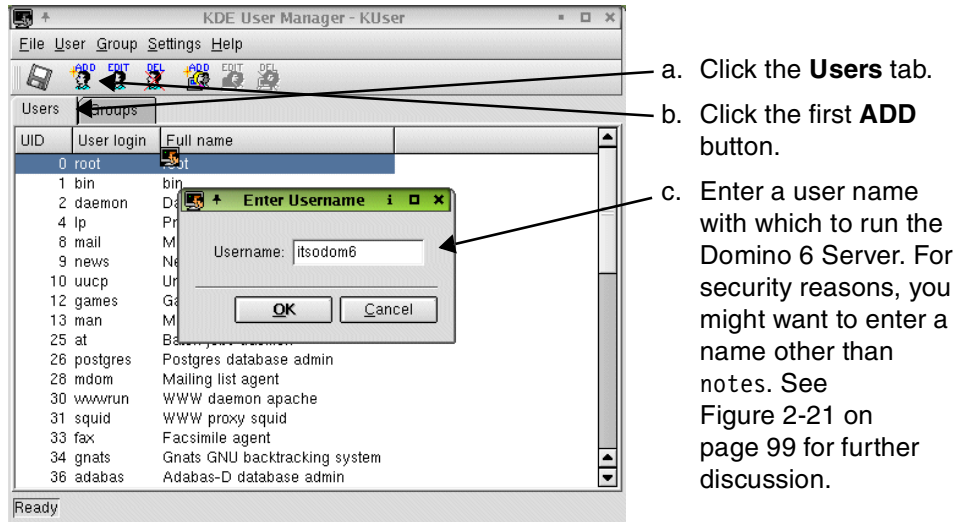


Figure 2-5 Add User with KDE User Manager

Click **OK** to submit the name; this will bring up the User Properties window shown in Figure 2-6.

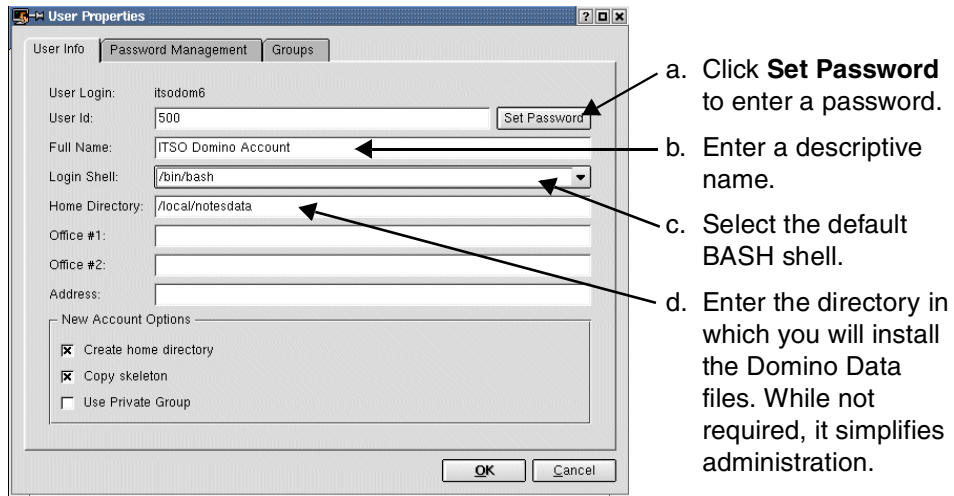


Figure 2-6 User Properties

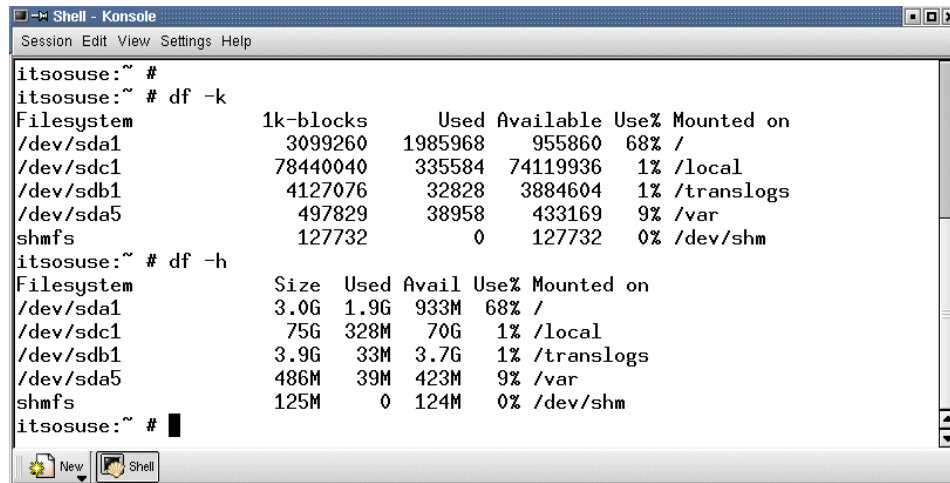
If you take a look at the Login Shell drop-down list in step c, you will see a lot of options. The shell you select is a matter of personal preference. Common shells are BASH, tcsh, and ksh. For the instructions and tips in this chapter, we assume you selected the default BASH shell as your login shell.

5. Make the user part of the group.

When you are finished with this tab, click the **Groups** tab. Scroll down the list of groups until you see the *notes* group we created earlier. Click the check box to make the new user a member of that group, then click **OK** to save your changes and exit the KDE User Manager.

6. Check the available disk space.

After checking that both the user and group exist and that they are correctly associated, the next step is to double-check the available disk space. The command **df -k**, and the human-readable **df -h**, shows the devices on the system and usage statistics. As you can see in Figure 2-7, we have enough space to install Domino into */opt/lotus* since the */* mount point has nearly 1 GB free. Since you are going to install the Domino 6 program files to the same mount point as the rest of the OS (this is equivalent to installing to the *c:* drive on an NT system), you should have at least 500 MB free. Refer to the Lotus Domino 6 documentation for the exact disk space requirements. If you do not have enough disk space, the Domino installation program will detect this condition and abort with an error message.



```
Shell - Konsole
Session Edit View Settings Help

itsosuse:~ #
itsosuse:~ # df -k
Filesystem            1k-blocks      Used Available Use% Mounted on
/dev/sda1              3099260    1985968    955860   68% /
/dev/sdc1             78440040     335584   74119936    1% /local
/dev/sdb1             4127076      32828   3884604    1% /translogs
/dev/sda5             497829      38958    433169    9% /var
shmfs                 127732         0     127732    0% /dev/shm
itsosuse:~ # df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/sda1             3.0G  1.9G  933M   68% /
/dev/sdc1             75G   328M   70G    1% /local
/dev/sdb1             3.9G   33M   3.7G    1% /translogs
/dev/sda5             486M   39M   423M    9% /var
shmfs                 125M    0   124M    0% /dev/shm
itsosuse:~ #
```

Figure 2-7 Two different ways to display disk usage

KDiskFree is a graphic tool to show free disk space. Invoke it by clicking **Start -> System -> File System Tools -> KDiskFree** on SuSE, or **Start -> System - KDiskFree (View Disk Usage)** on RedHat. The resulting display is shown in Figure 2-8 on page 90.

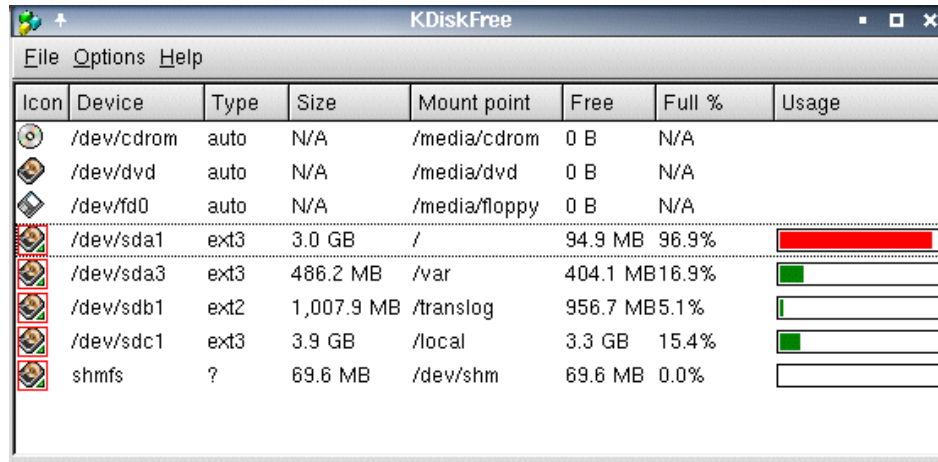


Figure 2-8 KDiskFree, Graphical disk usage tool

## 2.2 Domino 6 server install

Once you have verified that the OS is ready, it is time to install the Domino program files, configure the server and set up the initial databases, then launch the server.

**Important:** If you are running a multi processor machine, you *must* be running the 2.4.18 or above kernel.

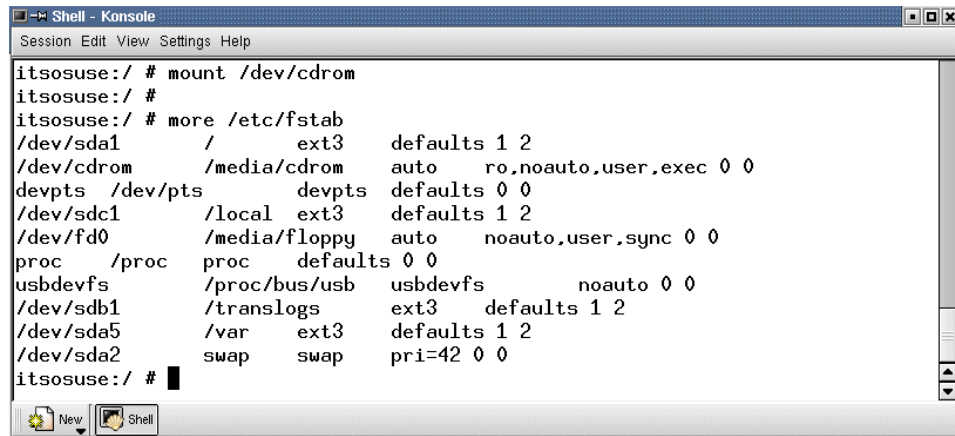
### 2.2.1 Installation

You can install from a tar file, where the files and directory information have been gathered into one file, or from a CD. This section assumes you are installing from a CD. If you have a tar file, follow the directions that came from the download site. Generally, you will issue the command **tar -xvf** to unpack the files, **cd** to change to the appropriate directory, and **./install** to begin. If the file ends with .gz or another symbol denoting compression, you will need to unzip it first with **gzip -d** or another appropriate program before using the **tar** command.

#### Mounting the CD-ROM drive

With the CD in the drive, you need to mount the CD-ROM device in order to alert the system that it is in use. If you are using KDE, you can click the CD-ROM icon; the device will automatically be mounted and the files displayed. From the command line, it is a bit trickier. Issue **mount /dev/cdrom** to incorporate the

CD-ROM in the file structure. To check where it will be mounted, type **more /etc/fstab**. **More**, its counterpart **less**, and **cat** are all simple programs that can be used to view files. Those new to Linux will quickly learn that there are numerous programs for each task—pick the one that suits your style.



```
Shell - Konsole
Session Edit View Settings Help

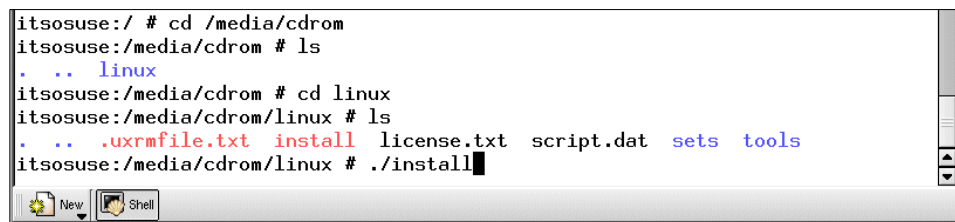
itsosuse:/ # mount /dev/cdrom
itsosuse:/ #
itsosuse:/ # more /etc/fstab
/dev/sda1      /          ext3      defaults 1 2
/dev/cdrom     /media/cdrom auto    ro,noauto,user,exec 0 0
devpts        /dev/pts   devpts   defaults 0 0
/dev/sdc1      /local    ext3      defaults 1 2
/dev/fd0       /media/floppy auto    noauto,user,exec 0 0
proc          /proc      proc      defaults 0 0
usbdevfs      /proc/bus/usb usbdevfs  noauto 0 0
/dev/sdb1      /translogs ext3      defaults 1 2
/dev/sda5      /var       ext3      defaults 1 2
/dev/sda2      swap       swap      pri=42 0 0
itsosuse:/ #
```

Figure 2-9 Display of the *fstab* file contents

The next entry after `/dev/cdrom` is `/media/cdrom`, so we know that the CD-ROM is now available by changing to the `/media/cdrom` directory. This is the default for SuSE 8.0. For Red Hat 7.2, the default mount point is `/mnt/cdrom`. The same process is used for the floppy drive: insert a floppy and type **mount /dev/floppy**. Again, KDE provides automatic mounting and file display by simply clicking the Floppy icon.

## 2.2.2 Starting the Domino server installation

Use the following steps to start the installation.



```
itsosuse:/ # cd /media/cdrom
itsosuse:/media/cdrom # ls
. .. linux
itsosuse:/media/cdrom # cd linux
itsosuse:/media/cdrom/linux # ls
. .. .uxrmfile.txt install license.txt script.dat sets tools
itsosuse:/media/cdrom/linux # ./install
```

Figure 2-10 Launching the *install* program

1. Change to the CD-ROM with **cd /media/cdrom** (SuSE) or **cd /mnt/cdrom** (RedHat).

2. Change to the Linux folder with **cd linux**
3. Type **ls** to view the directory contents (same as DOS **dir**).
4. Type **./install** to launch it.

The **./** in step 4 tells the OS to look in the current directory for the executable named **install**. For security reasons, **./** is not added to the root PATH environment variable since you could be tricked into launching a malicious program from a current directory, such as the **/tmp** folder. The PATH environment variable is the same as the PATH variable in DOS and NT.

## Domino server installation steps

The Domino server installation program will launch, and you will first see the Welcome screen.

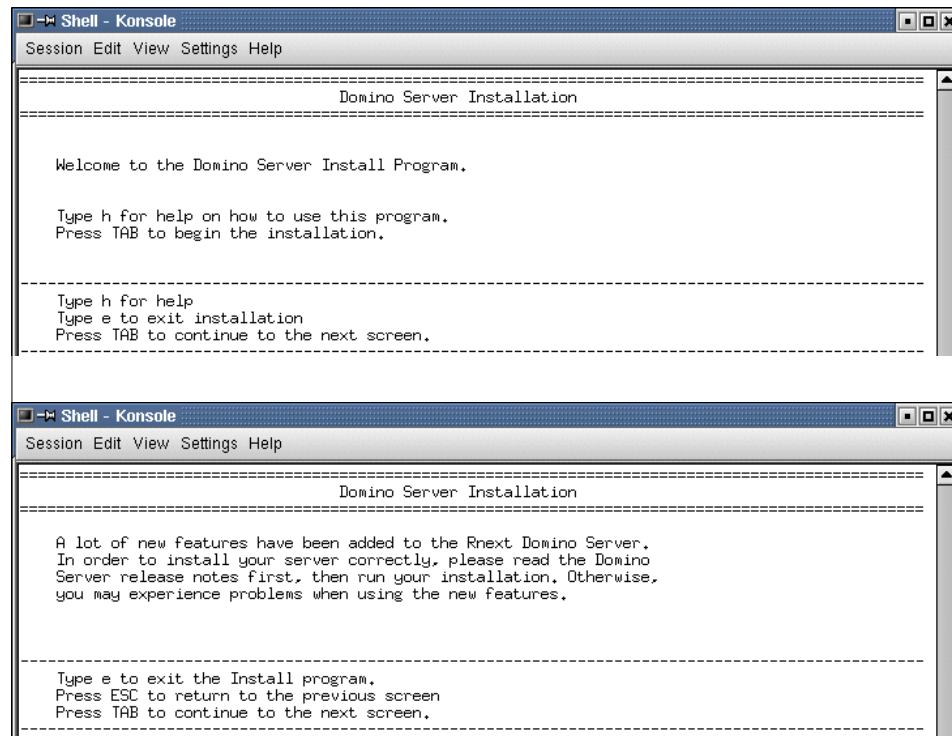
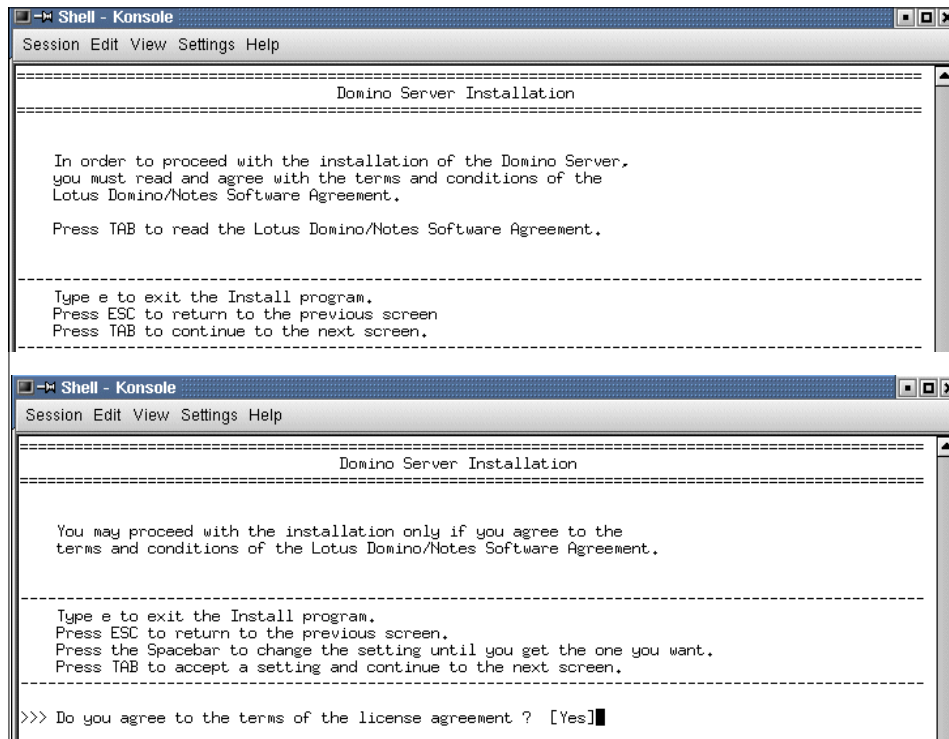


Figure 2-11 Domino Install Welcome and New Feature Alert

Throughout the installation, you will press the Tab key to move on. (This is comparable to clicking **Next** in a standard GUI). Press Tab and you will see the second screen shown in Figure 2-11, which is simply an alert regarding the new features available in Domino 6. Press Tab to continue.



*Figure 2-12 Domino License Agreement*

After you have read and accepted the license shown in Figure 2-12, press Tab.

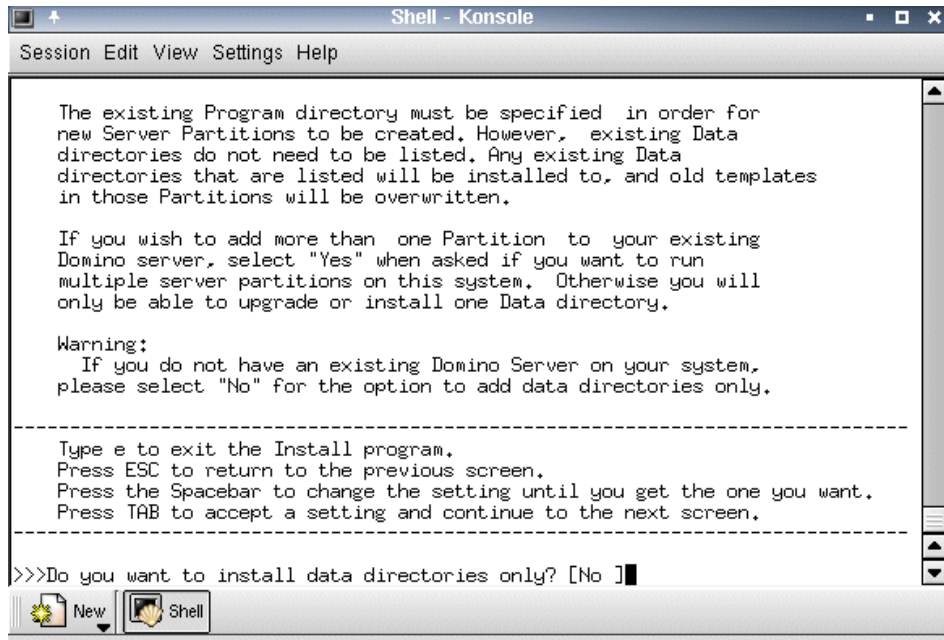


Figure 2-13 Install Data directories only

You will need to select the type of server you wish to install: Utility, Messaging, or Enterprise. To cycle through the available choices, press the spacebar until the option you want is displayed. Since we will be using clustering, which is an advanced service available only with Enterprise, we selected Domino Enterprise Server as shown in Figure 2-14.

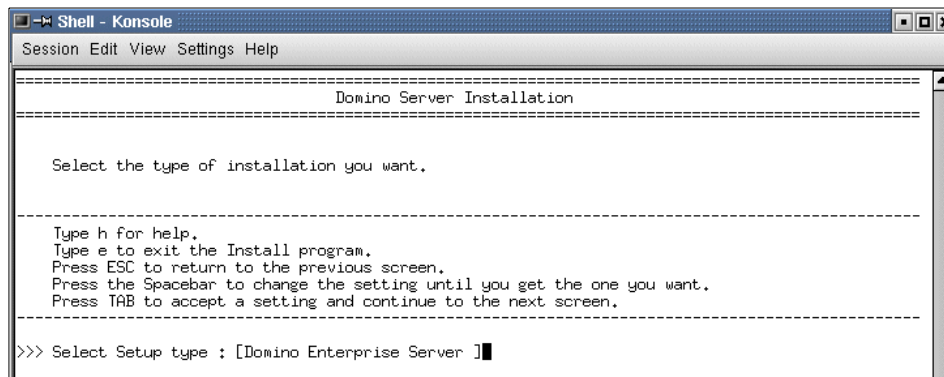


Figure 2-14 Type of Domino server to install



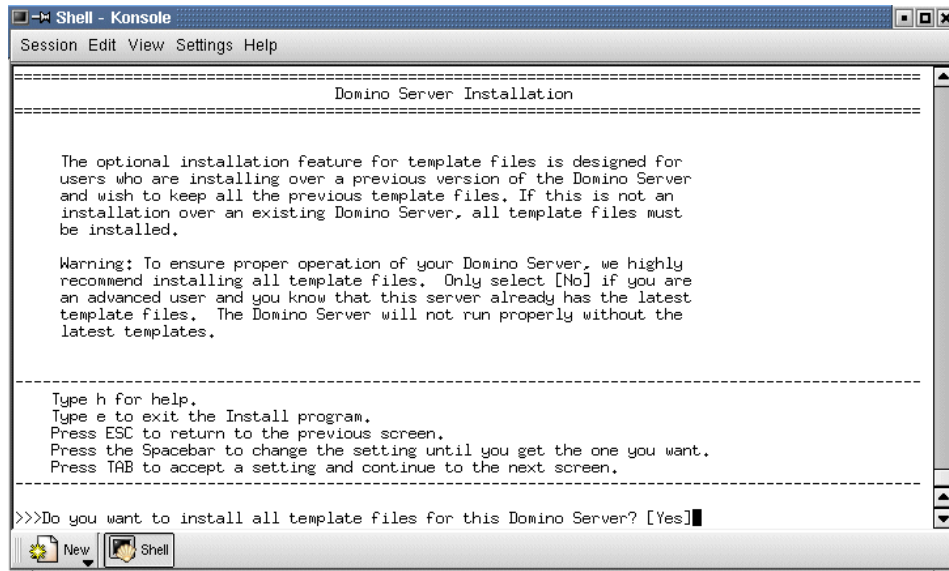


Figure 2-15 Template selection

A new option with Domino 6 is the ability to install a subset of templates instead of automatically installing every template. In general, however, you'll probably want to install all templates in order to take advantage of new features and bug fixes.

If your company has customized any of the templates, evaluate the changes made in light of the new functionality provided by Domino 6. If the customizations are still required, you will need to apply them *after* the installation completes. Press Tab to install all templates.

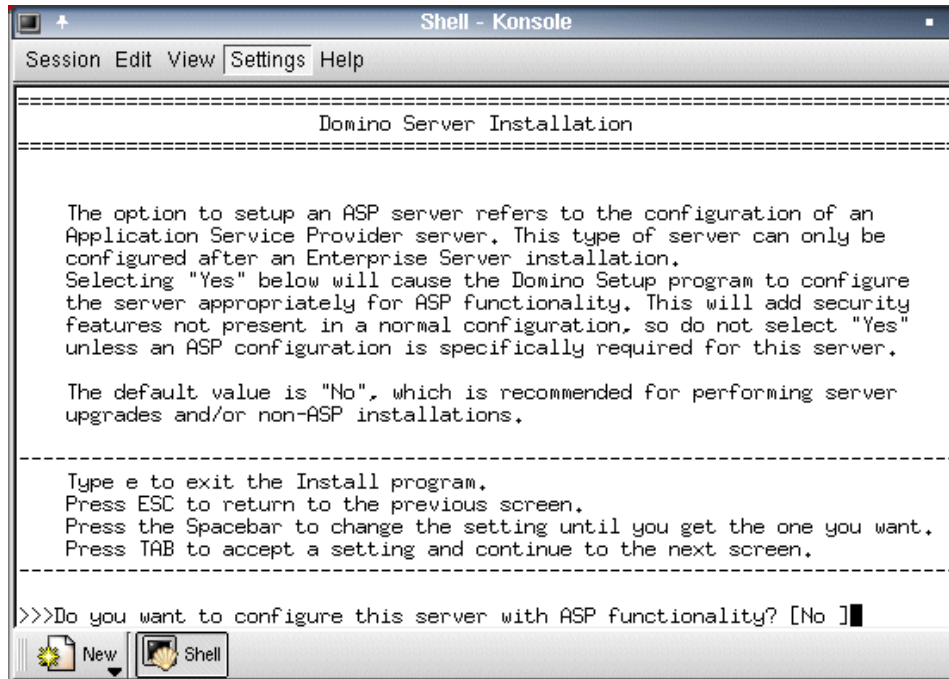


Figure 2-16 Configure ASP functionality

Press Tab.

**Attention:** ASP support is Application Service Provider and has nothing to do with Active Server Pages.

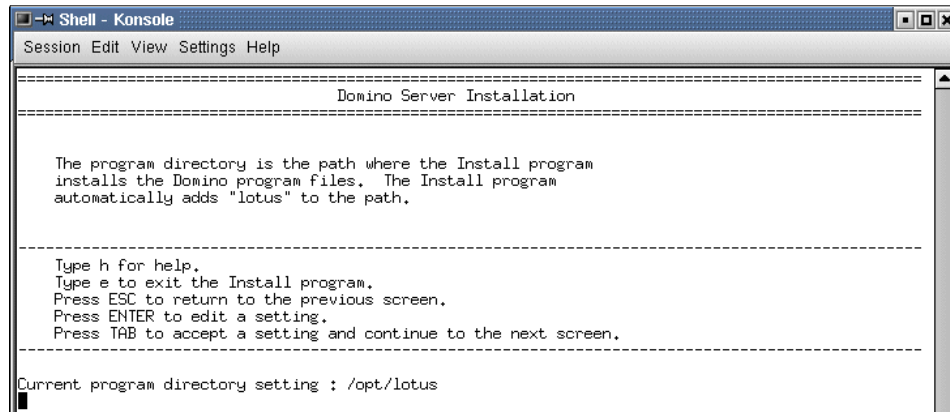


Figure 2-17 Location for the Domino program files

With R5, you did not have to install the program files to /opt/lotus, but the server required an /opt/lotus symbolic link in order to function properly. Domino 6 no longer requires the /opt/lotus link, and so Domino 6 can co-exist with R5 (still using /opt/lotus) or with other installations of Domino 6.

Table 2-1 Example of multiple installations

Version of Domino	Program file installation path
Domino R5	/opt/lotus
Domino 6	/opt/dom6a/lotus
Domino 6	/opt/dom6b/lotus

**Important:** If you have Domino R5 installed on a server, then even if the program files are *not* installed in /opt/lotus, you cannot install Domino 6 to that directory. Doing so will overwrite the symbolic link and the R5 install will no longer function properly.

For our single server, we chose to install only one version of Domino 6 and so pressed Tab to accept the default path.

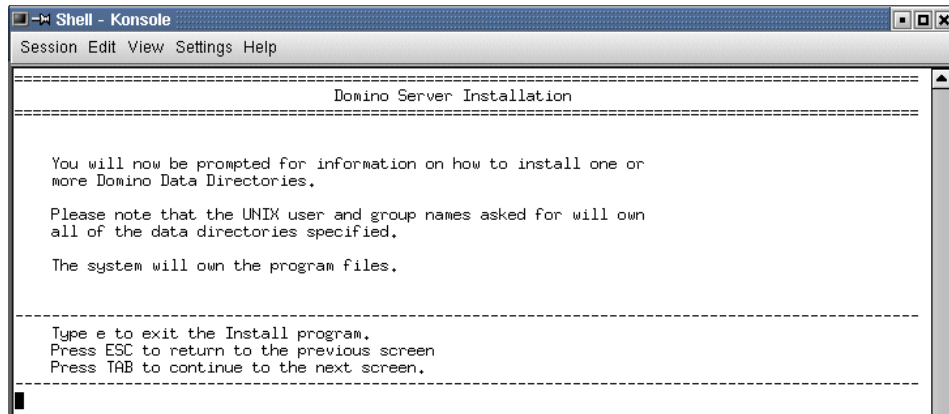


Figure 2-18 Explanation of Linux file ownership

Figure 2-18 outlines the basic file ownership concept of Domino running on Linux. The user and group you specify will own the data and will be used to launch the server. The file permissions for the program files, however, will be set to root for required access to the system.

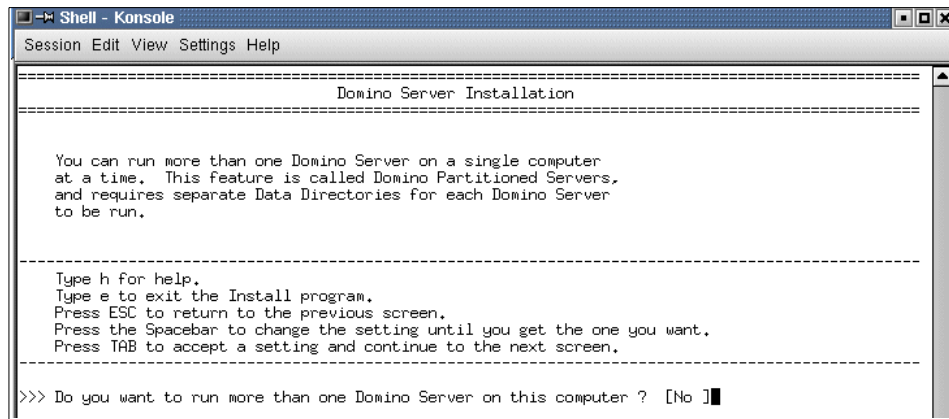


Figure 2-19 Partition Server option

While Domino 6 gives you the ability to run different versions of Domino on a single server, you still have the option to partition a server. If you partition the server, multiple instances of Domino will share *one* set of program files but each installation will have a separate data directory. The new Domino 6 feature that allows multiple installs requires *separate* program files, as well as *separate* data directories, for every instance, and so requires more disk space than partitioning. For our server, we chose not to partition it.

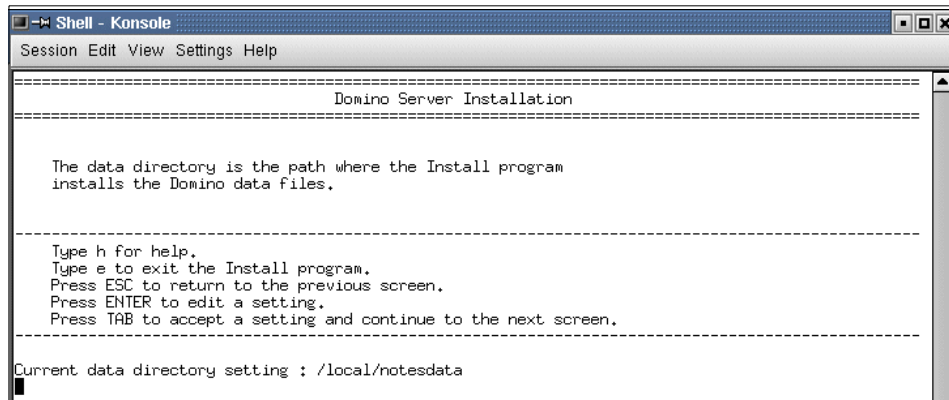


Figure 2-20 Location for the Domino Data Directory

Press Tab to accept the default directory shown in Figure 2-20.

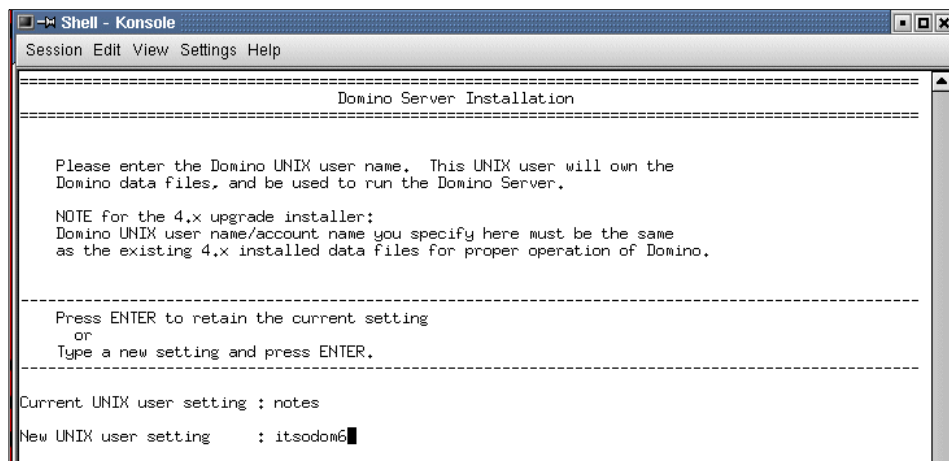
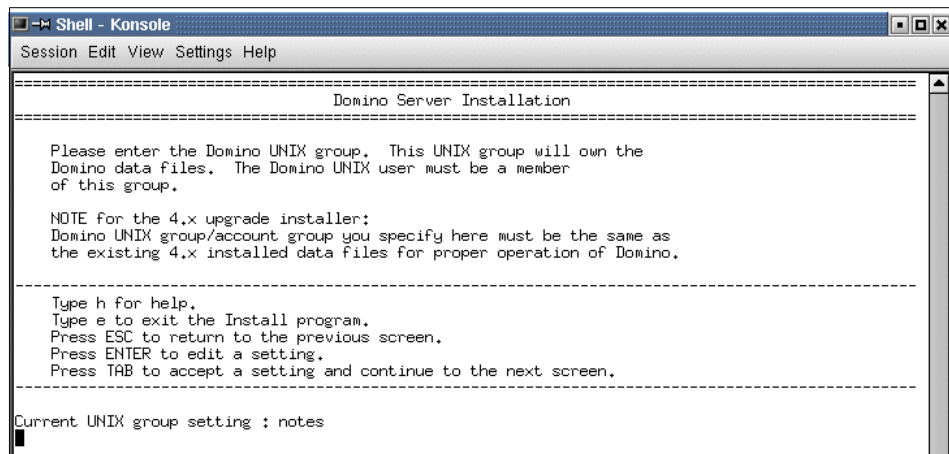


Figure 2-21 Linux user account for Domino

Since it makes it easier for hackers to break into your system if they can readily guess an account name, you might not wish to use the default username of *notes*. We opted to name our account *itsodom6* since it reflects our group and the version of Domino about which we are writing. Note that simply changing the name of the account *does not*, by itself, make your installation secure.

To change the account name, press Enter, type in the user name, press Enter again, then Tab.

**Tip:** From KDE, you can switch to the KDE User Manager program, create (or rename) the user account as shown in Figure 2-5 on page 88, then resume the installation. You do not need to abort the install.



*Figure 2-22 Linux group for Domino*

Enter the name of the group you created earlier. We chose the default of notes.

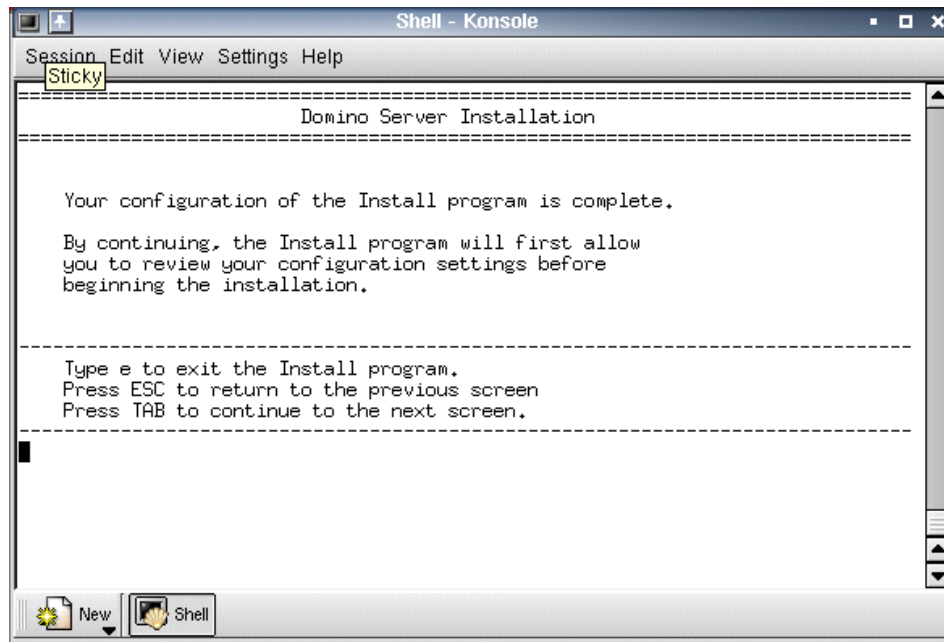


Figure 2-23 Configuration complete

Press Tab.

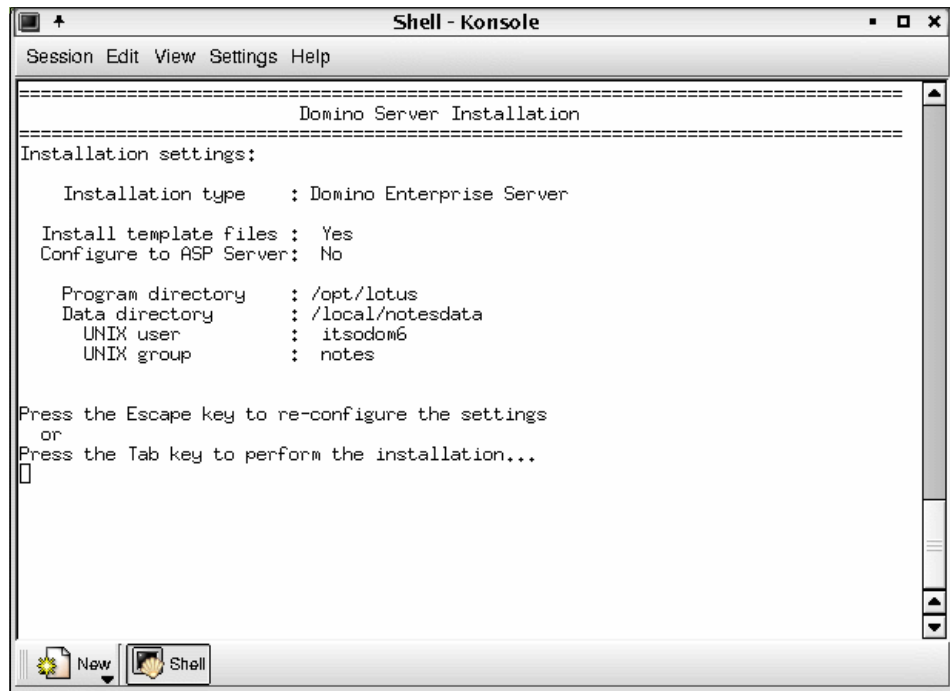


Figure 2-24 Perform installation

Press Tab if you are satisfied with the configuration.



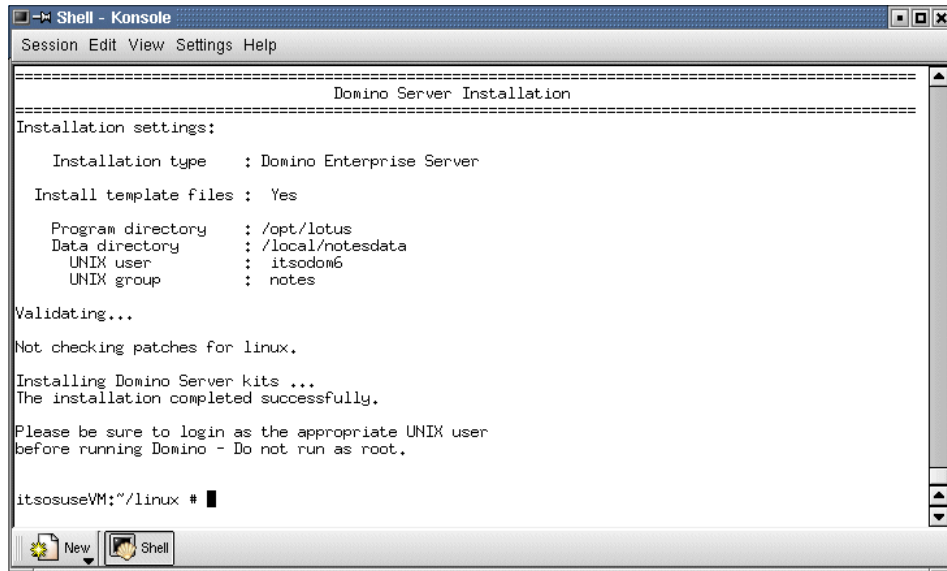


Figure 2-25 Installation complete

You will be given a chance to review the information entered, as shown in Figure 2-25. If you entered something incorrectly, press Esc (this is comparable to clicking **Back** in a GUI) to correct it. When ready, press Tab to install Domino 6. When the installation finishes, you will be returned to the command prompt.

**Important:** For those of you familiar with R5 or earlier versions of Domino, do *not* type `http httpsetup` unless you don't have X-Windows installed. Domino 6 ships with a new Java installation program that can be run locally or remotely.

If you receive an error message, you will need to fix it, then re-run the installation from the start. A typical error message involves either incorrectly specifying the user or group, or else failing to create the user or group before beginning the installation. Another common error message concerns lack of disk space. You can avoid both of these errors by following the steps outlined in 2.1, “Before you begin: Pre-installation tasks” on page 84.

### 2.2.3 The CheckOS tool

CheckOS is a script used to verify that the operating system contains the appropriate patch level in order to run Domino 6. The script is installed during Domino installation and resides in the Lotus Binaries directory (that is, `/opt/lotus/bin/checkos`).

The CheckOS tool can also be downloaded from the Iris Sandbox at:

<http://www-10.lotus.com/ldd/sandbox.nsf/Threads/192F30EDB7F28DB300256BF1004A1CC E?OpenDocument>

## Running the CheckOS tool

You must be logged into the system as the root user.

Change your directory to the Lotus binaries directory. The default would be:

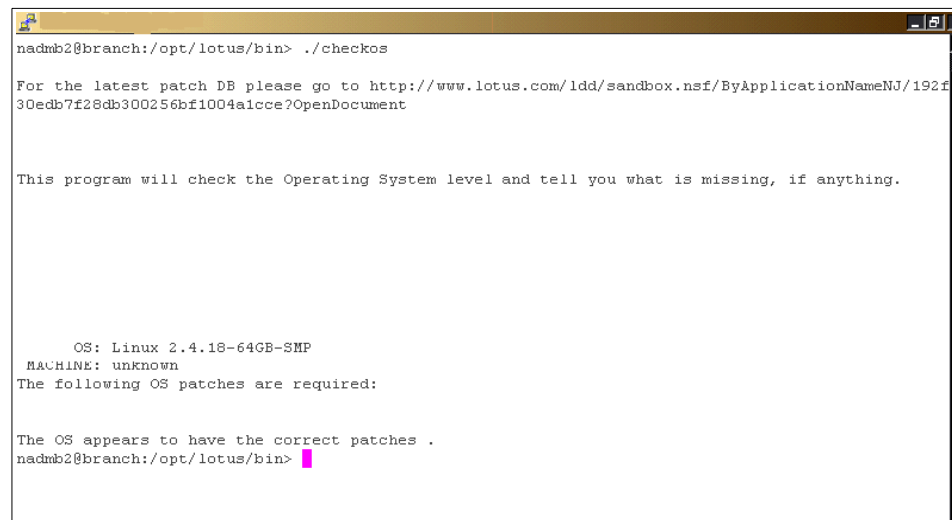
```
cd /opt/lotus/bin
```

Now type in `./checkos` to start the script.

**Note:** If you get an error or the script doesn't run, check to see if you are in the Lotus binaries directory. Also, by issuing an `ls` you should be able to see the checkos file. If the file does not exist then the install may not have completed.

## CheckOS explained

First you will see a couple of lines, including a link to the latest patches, and a line of information while the tool gathers the data. Next, the script checks and reports which OS you are running on the system, followed by the machine type, and filesets required for the Domino 6 server to run properly. If there are any filesets missing, they will be reported in the section “The following OS patches are required:” You need to install the missing patches before continuing.



```
nadmb2@branch:/opt/lotus/bin> ./checkos

For the latest patch DB please go to http://www.lotus.com/ldd/sandbox.nsf/ByApplicationNameNJ/192f30edb7f28db300256bf1004a1cce?OpenDocument

This program will check the Operating System level and tell you what is missing, if anything.

OS: Linux 2.4.18-64GB-SMP
MACHINE: unknown
The following OS patches are required:

The OS appears to have the correct patches .
nadmb2@branch:/opt/lotus/bin> █
```

Figure 2-26 CheckOS Script

## 2.2.4 Setup

Now that you have successfully installed Domino 6, it is time to configure and set up the server. Log out as root and back in under the notes user account so that it, and not root, owns the X-Windows session.

### Setting the Linux PATH environment variable

Before you begin, you are going to make a quick change to your shell environment to make it more user friendly. If you installed Domino 6 to a different directory than the default, you will need to replace `/opt/lotus/bin` with the path you chose.

Normally, commands are given with the full path, for example `/opt/lotus/bin/server` for the server executable. Linux searches your PATH environment variable for executables, so you are going to add `/opt/lotus/bin`, as well as the current directory, to your PATH. Make certain you are logged in with the Domino user account and not as root. You can check this by issuing the command `whoami` or `id`.

Start the KATE editor. The program automatically begins with a new file (file needs to be called `.bash_profile`, as shown later) so all you need to do is enter the following line:

```
export PATH=$PATH:/opt/lotus/bin:./
```

**Note:** Linux is case-sensitive, and PATH must be upper case.

This preserves the existing path and simply appends our additions.

Click **File -> Save** to open the Save File dialog box.

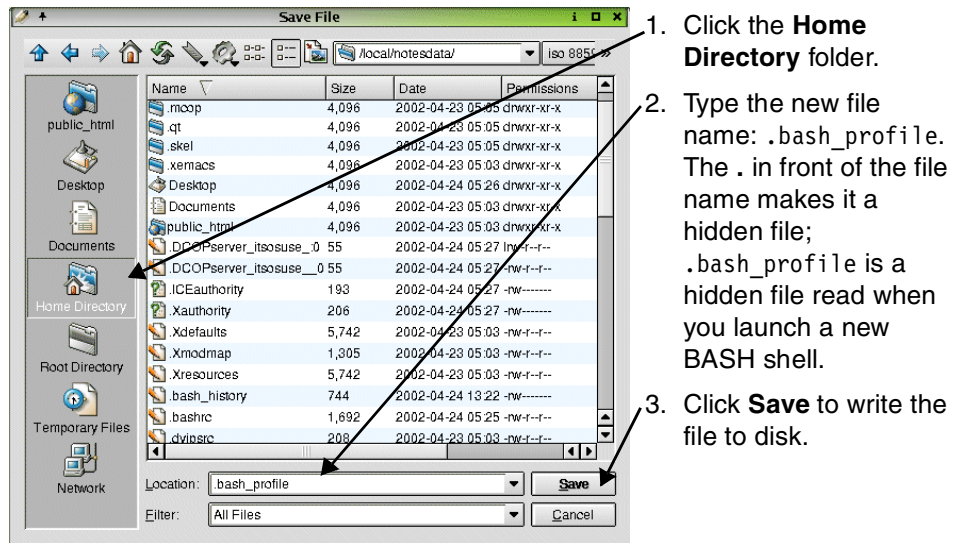


Figure 2-27 KWrite Save File dialog box

Log out and log back in for the changes to take effect.

**Note:** If you started X-Windows from the `startx` command, make sure that you log out and *not* just restart X-Windows. To log out, use the `exit` command or `ctrl-d`.

You can check that the `PATH` variable was set correctly by launching a shell and typing `echo $PATH` at the command prompt. To verify that you are using the Domino server executable, type `which server` and check the path.

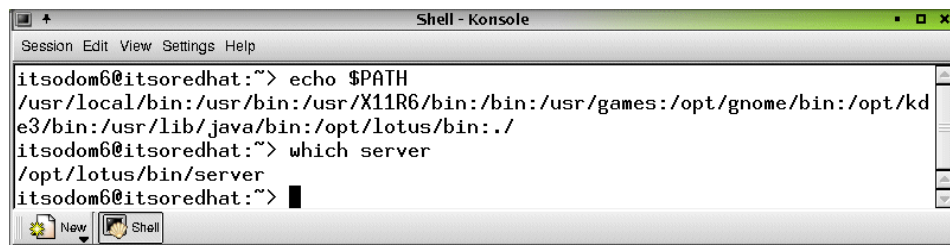


Figure 2-28 `echo` and `which` commands

Change to your Domino data directory (in our case it was the `/local/notesdata` directory) before starting the Domino Server setup. You must be in the Domino data directory when you start the server.

**Note:** When the notes user account was set up, the home directory should have been set to the Lotus Domino data path: /local/notesdata.

## 2.2.5 Remote setup

**Note:** We recommend remote setup because it gives you the ability to download the server and certifier ID files to your local workstation.

The new Java setup also allows for remote configuration. The setup is virtually the same as the local setup.

1. To run the remote setup, you must have installed the Lotus Administrator with the remote server setup option (see Figure 2-29) on your workstation.

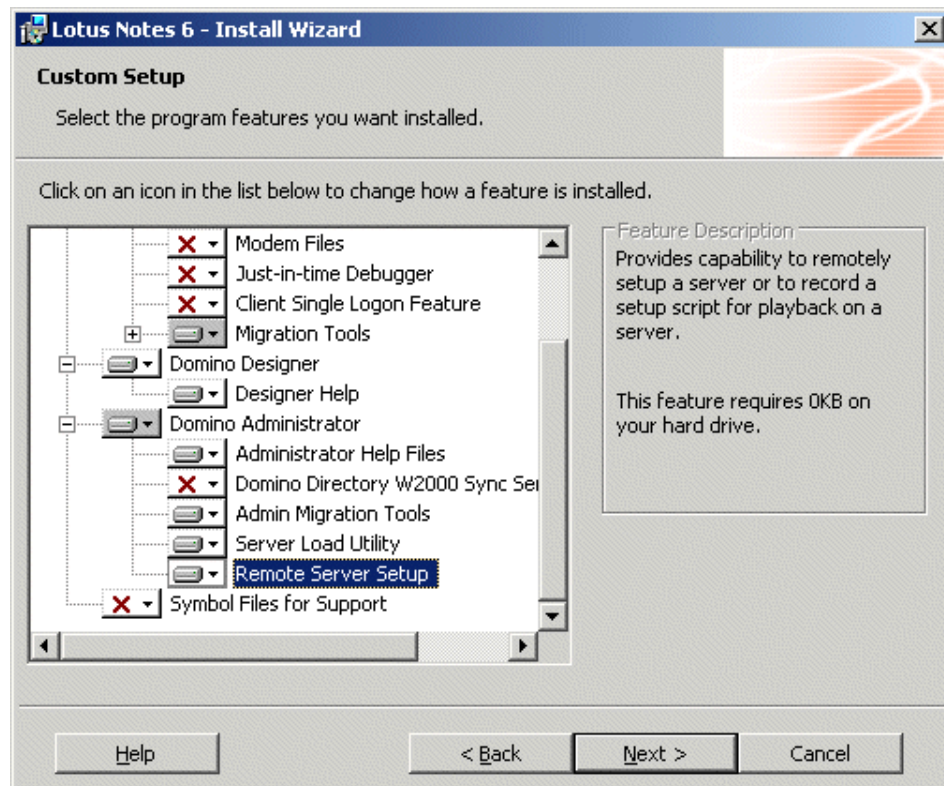


Figure 2-29 Lotus Administrator remote server setup option

2. Log on to your server with the Domino user account (itsodom6), change to the Domino data directory (/local/notesdata) and start the Domino server with the listen option (see Figure 2-30).

**Important:** Make sure that the system LANG variable is set correctly for your language, that is, LANG=en\_US, LANG=de\_DE@euro. To set the system variable type **LANG=**.

```
[notes@RHDOM6 notesdata] $ /opt/lotus/bin/server -listen
./java -ss512k -cp jhall.jar:cfgdomserver.jar:Notes.jar lotus.domino.setup.WizardManagerDomino -data /local/notesdata -listen
Remote server setup enabled on port 8585.

The Domino setup server is now in listening mode.
A remote client can now connect to this server and configure Domino.

To connect to this server, launch the Remote Domino Setup program from a command-prompt as follows:
From a Domino administrator client: serversetup -remote
From a Domino server: server -remote

To end this server, launch the Remote Domino Setup program from a command-prompt as follows:
From a Domino administrator client: serversetup -q
From a Domino server: server -q

For more information, see the printed guide Setting Up Domino Networks and Servers.

—
```

*Figure 2-30 Domino server with listen option*

3. Go to a command prompt, change to the Domino Administrator programs directory, and start the Java configurator (serversetup.exe) as shown in Figure 2-31 on page 109.

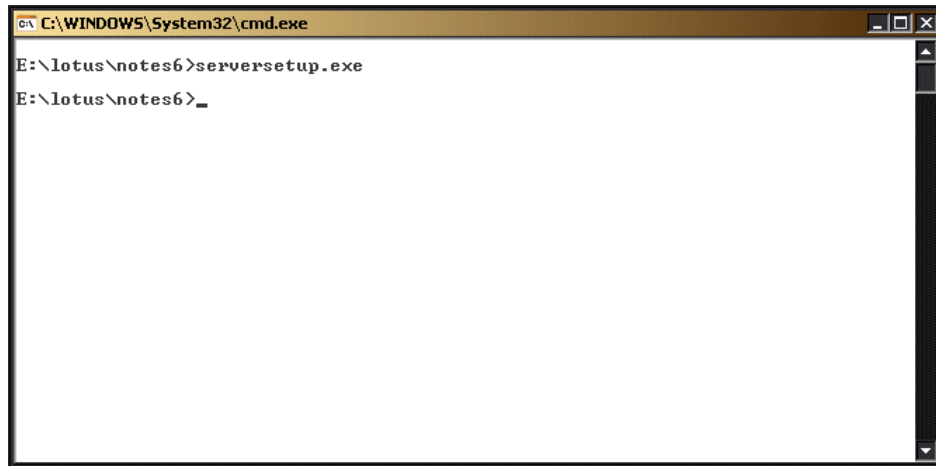


Figure 2-31 Java setup program serversetup.exe

4. Enter either the server's name or IP address in the Remote Host Address field and click **Ping**. (See Figure 2-32.)

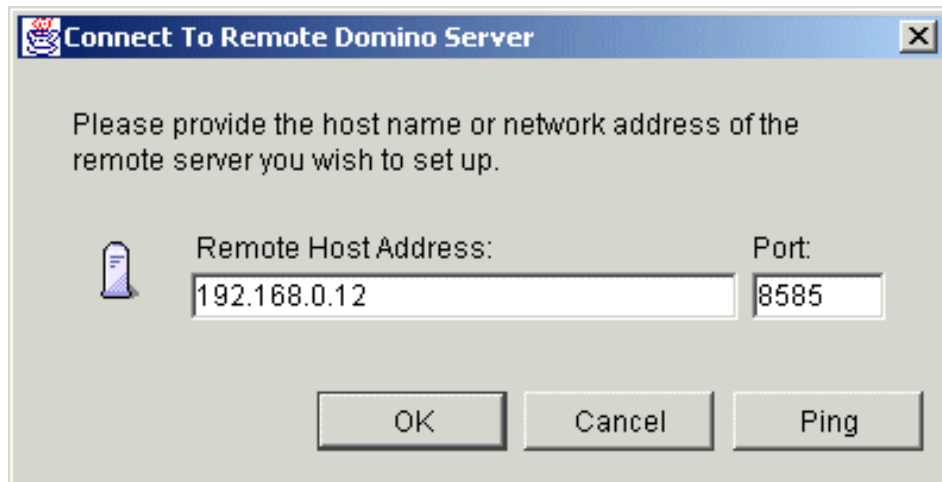


Figure 2-32 Connect to remote server

5. If the remote server is set up correctly and the network is functioning, then you should see a message like Figure 2-33 on page 110.

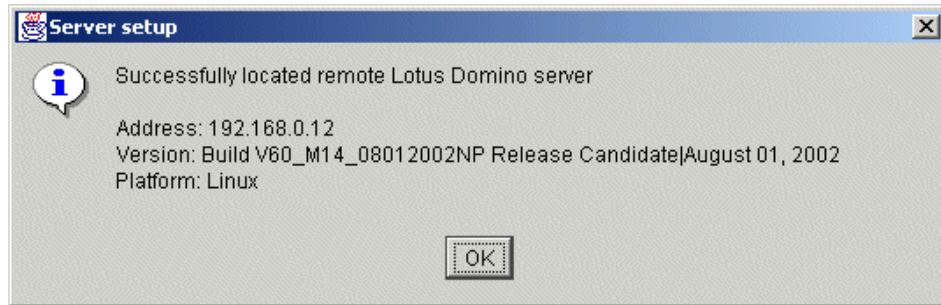


Figure 2-33 Successful ping

6. Now click **OK**.

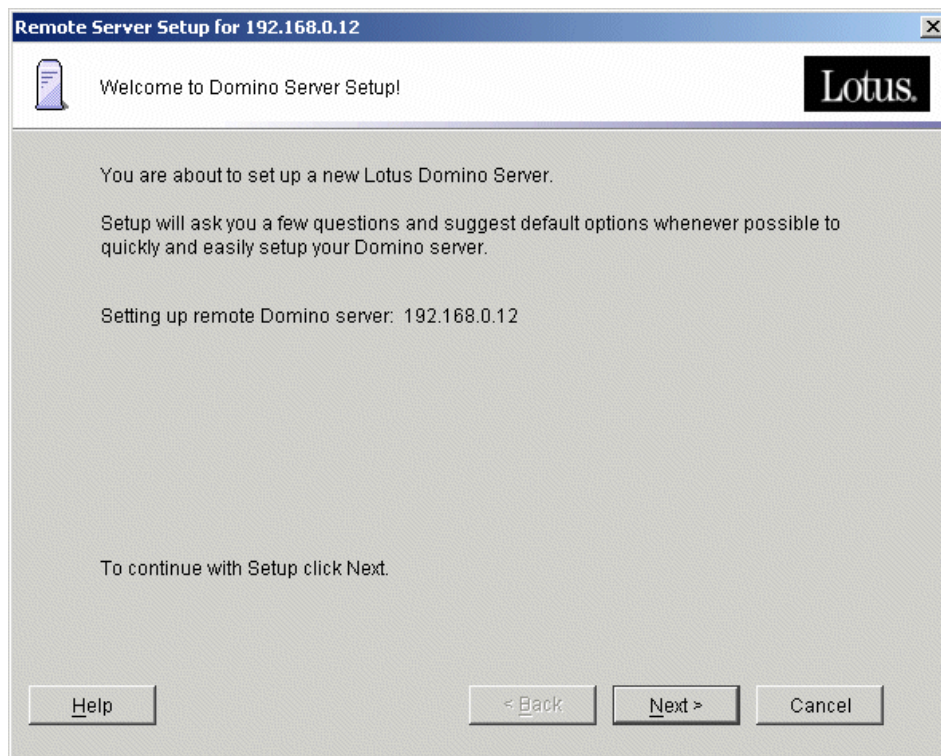


Figure 2-34 Starting remote configuration

Click **Next** and you will see the screen shown in Figure 2-34.



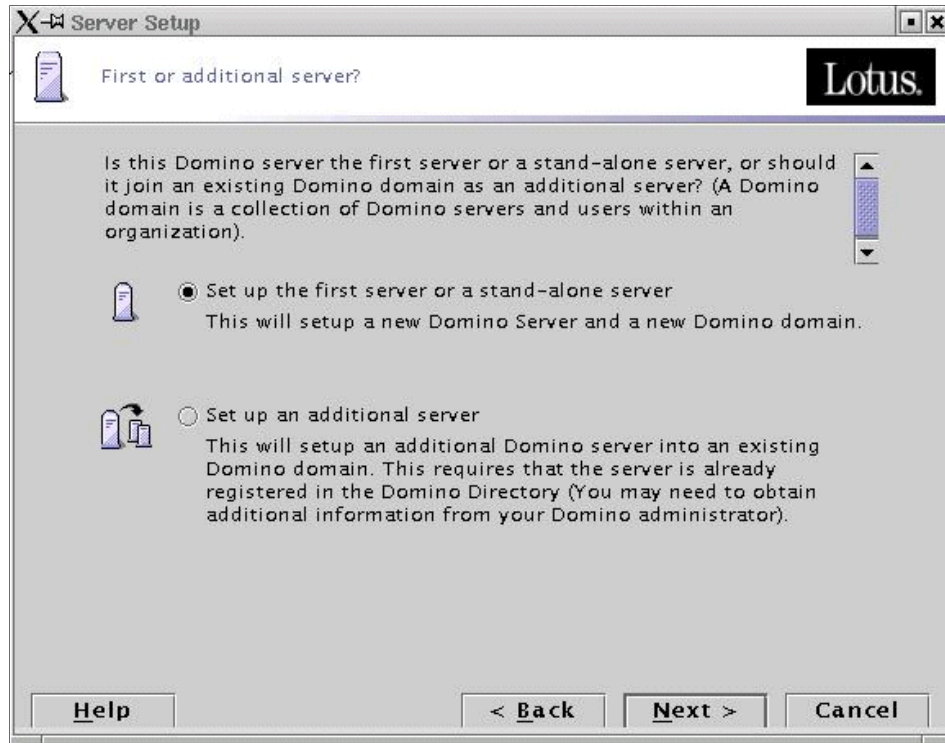


Figure 2-35 First or additional Domino server

7. You are setting up the first server in what will be your new ITSO domain. If you are setting up an additional server, you will be prompted to specify the location of your server ID and the hierarchical name of the additional server. Once you have done so, you can skip ahead to Step 12 on page 116. Click **Next** to continue.

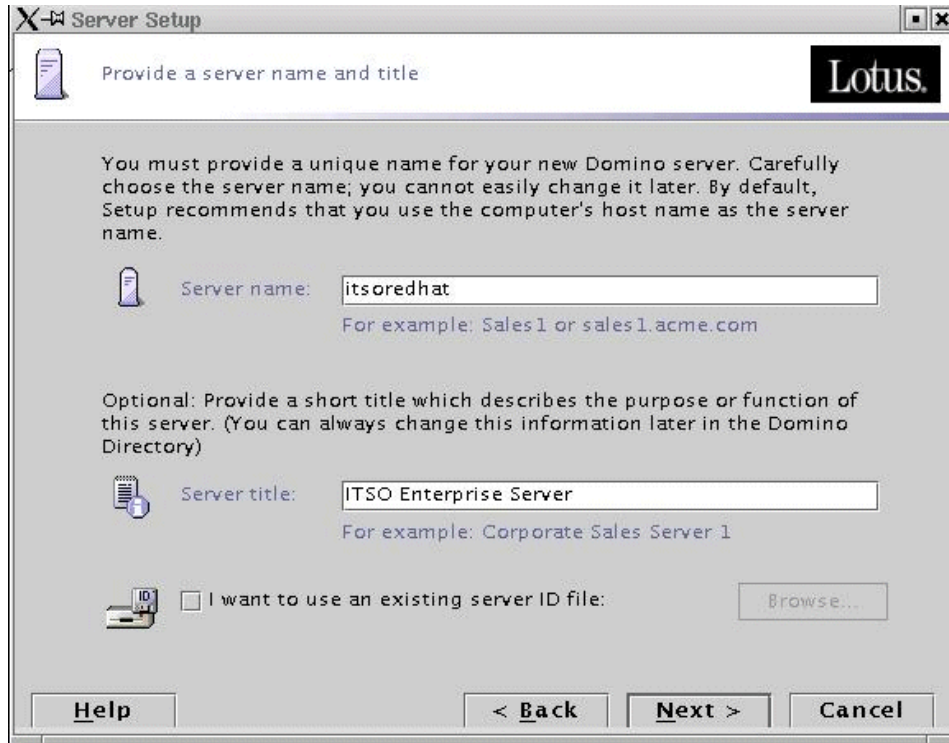


Figure 2-36 Domino server name and title

8. We have set the server name to be the same as the host name. This is a good idea for a number of reasons, one being that when a Lotus Notes client attempts to locate a server, it will query DNS using the common name of the server. If the common name matches the host name, the client will be able to locate it even if the server resides in a different domain from the user's home server.

The title gives you an opportunity to provide a terse description of the server's main function or the organization to which it belongs.

Click **Next** to continue with the installation.

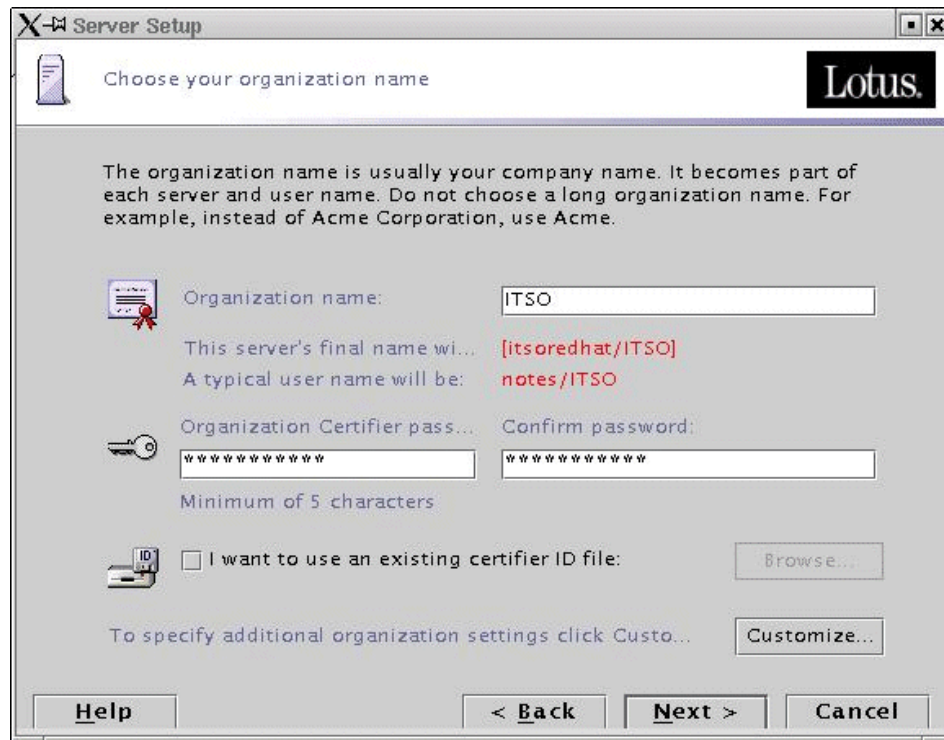


Figure 2-37 Domino organization name

9. Set a meaningful Organization name, and make certain to enter a secure password for your Certifier ID, then click **Next** to proceed.

If you are rebuilding your Domino domain, you can check the “I want to use an existing certifier ID file” to do so.

**Important:** The Certifier ID is the key to all user and server authentication; it should be removed from the server immediately after you have finished the setup and stored in a secure location. You should also rename the file (it will be named cert.id by default) to include the Domino domain name, especially if you manage or intend to manage multiple domains. Do not forget, however, that you will need the Certifier ID in order to create subsequent Organizational Units (OUs). Additional OUs are useful for distinguishing people from servers, as well as distinguishing departments or regions. You should settle on a scheme that minimizes the number of OUs but provides sufficient detail. See *Domino 6 Administration Help* for further details.

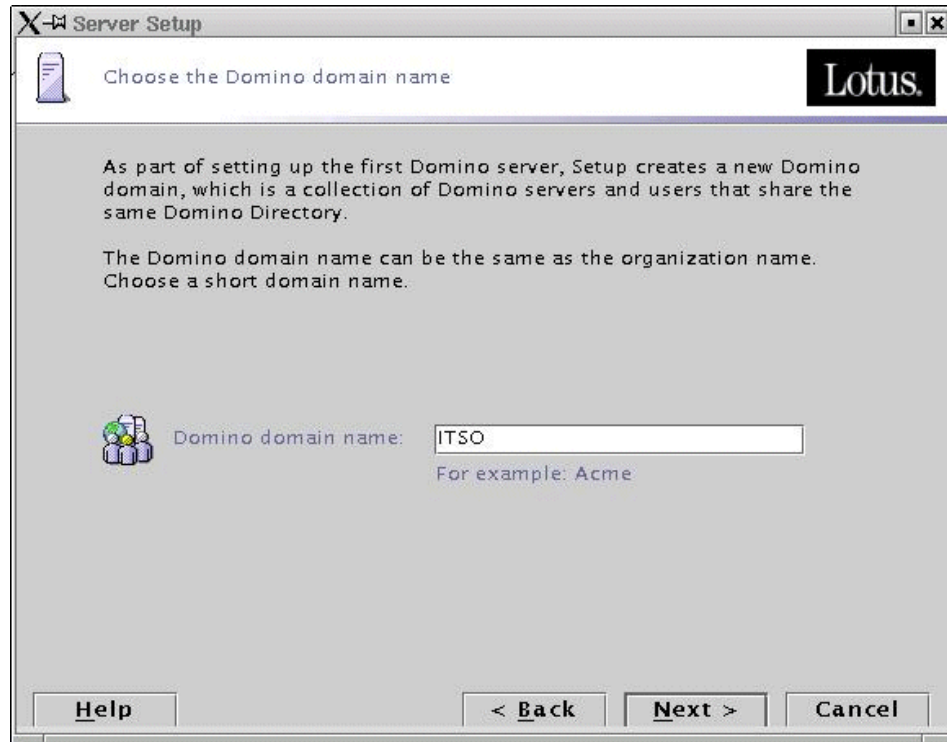


Figure 2-38 Domino domain name

10. For ease of administration and use, we made the Domino domain name the same as the Organization name.

**Tip:** If you intend to have multiple domains, you should decide on a naming scheme now and make certain the first domain conforms to the scheme you will use for all subsequent domains.

Type the name you would like to use and click **Next**.

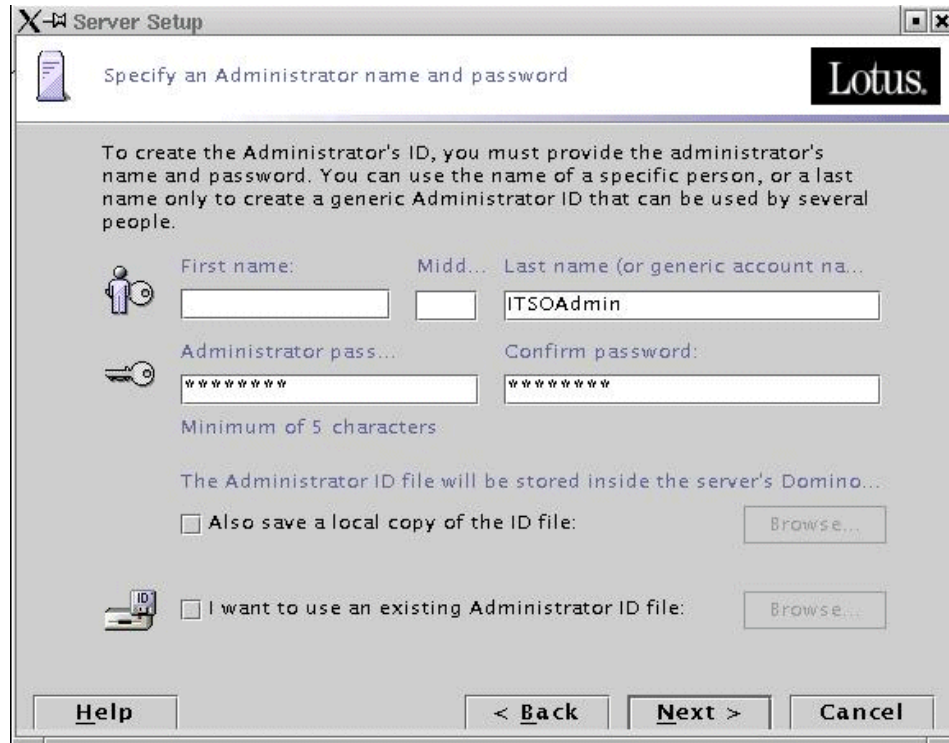


Figure 2-39 Domino Administrator name and password

11. Enter an administrator name and password, then click **Next**.

We opted to create a generic Administrator ID and download it to our client via a Web browser. If you intend to use the ID locally, check the “Also save a local copy of the ID file” option so that you will have easy access to the ID. Since the Administrator ID will have full access to the Domino Directory, we removed the ID from the Person document after we downloaded it.

**Important:** Don’t select “Also save a local copy of the ID file” if you are running a remote installation because it will try to access the local file system on the server which you don’t have access to. There is an option later in the remote setup to copy the ID files to your local workstation.

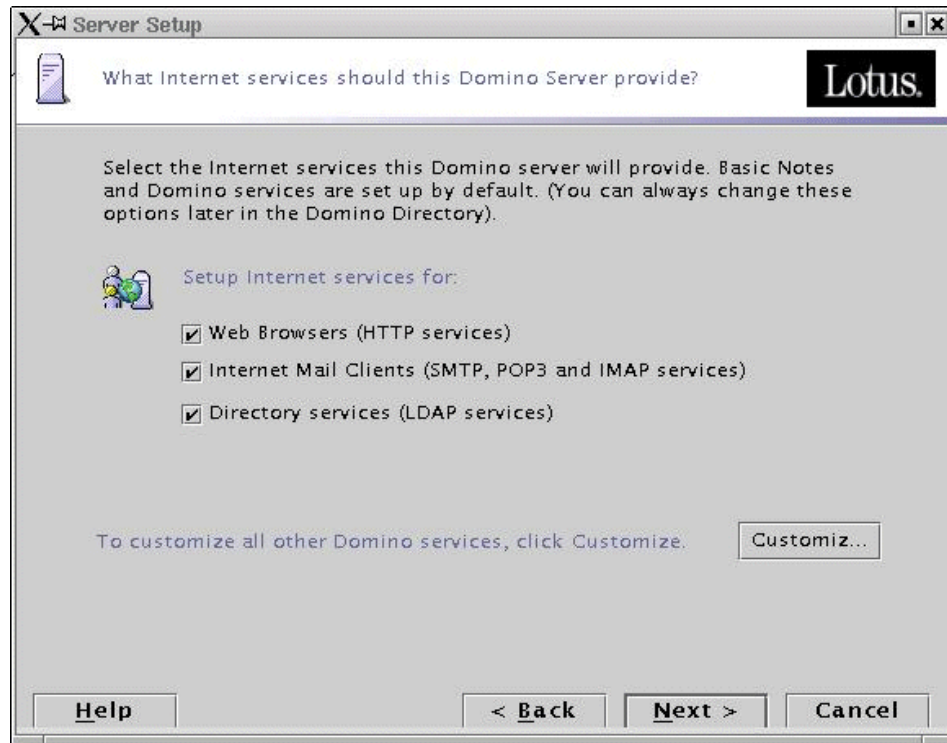


Figure 2-40 Internet Services provided by Domino

12. Select all three options shown in Figure 2-40, then clicked **Customize** to further refine your selections.

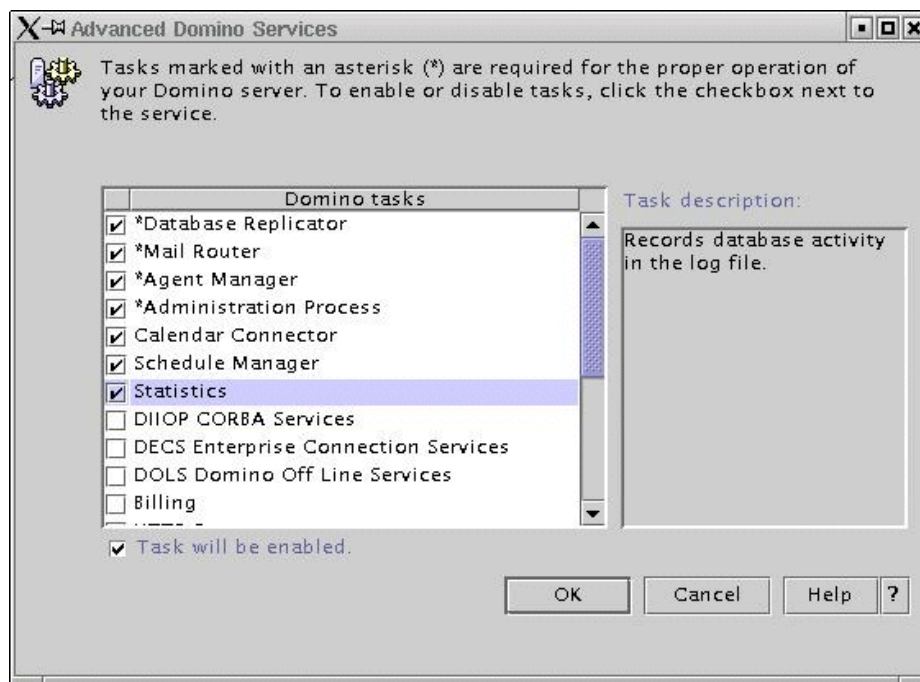


Figure 2-41 Advanced Domino services: Part I

13. We selected Calendar Connector, Schedule Manager, and Statistics to provide the features needed for this server. You will need to consider which services are appropriate for the server you are setting up and select only those that you need.

**Tip:** You can always add a service later by modifying the **ServerTasks=** line of the **notes.ini** or issuing a **set config servertasks=** command from the Domino console. With the **set config** command, you need to enter every service you would like to have running, not just the ones to add. You can see the existing services by typing **show config servertasks**.

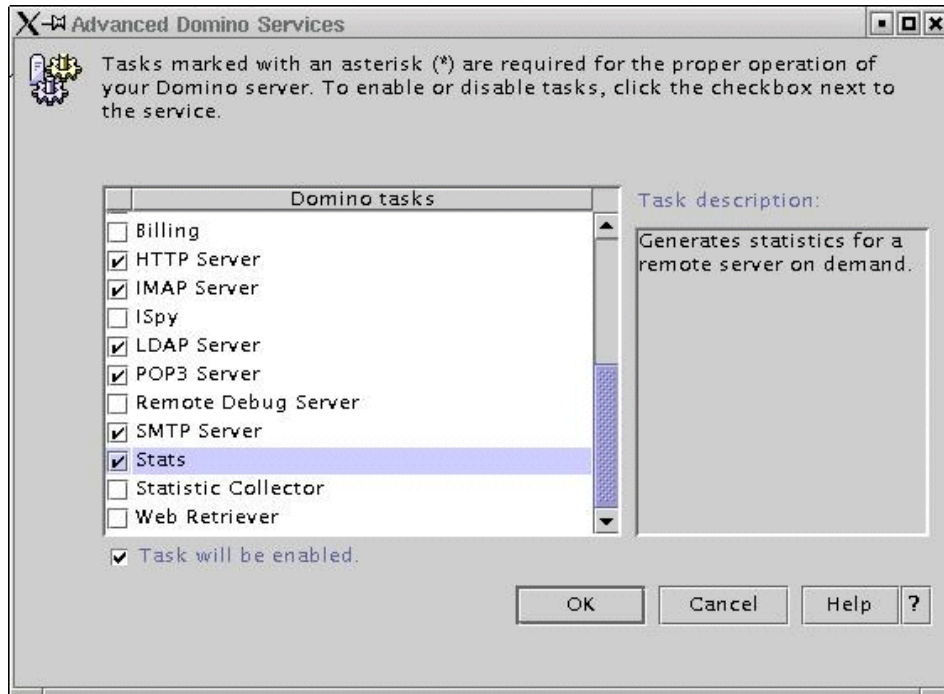


Figure 2-42 Advanced Domino services: Part II

14. We selected HTTP for Web services; IMAP and POP3 for mail client access; SMTP for native mail delivery; LDAP to provide the Domino directory to LDAP clients; and Stats for on-demand statistics. Again, you should select only the services you need based on the intended use of your server. Click **OK**, then click **Next**.



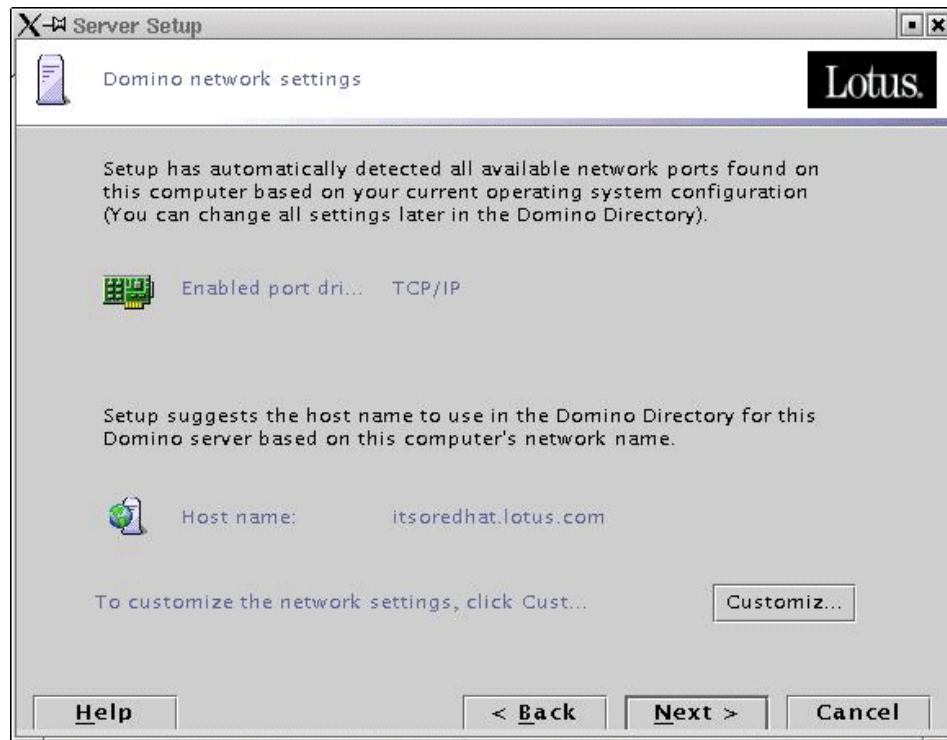


Figure 2-43 Domino network settings

15. The auto-detect correctly determined our network port and host name, as shown in Figure 2-43. We then clicked **Customize** to enable encryption; you would also click **Customize** to correct the detected network ports.

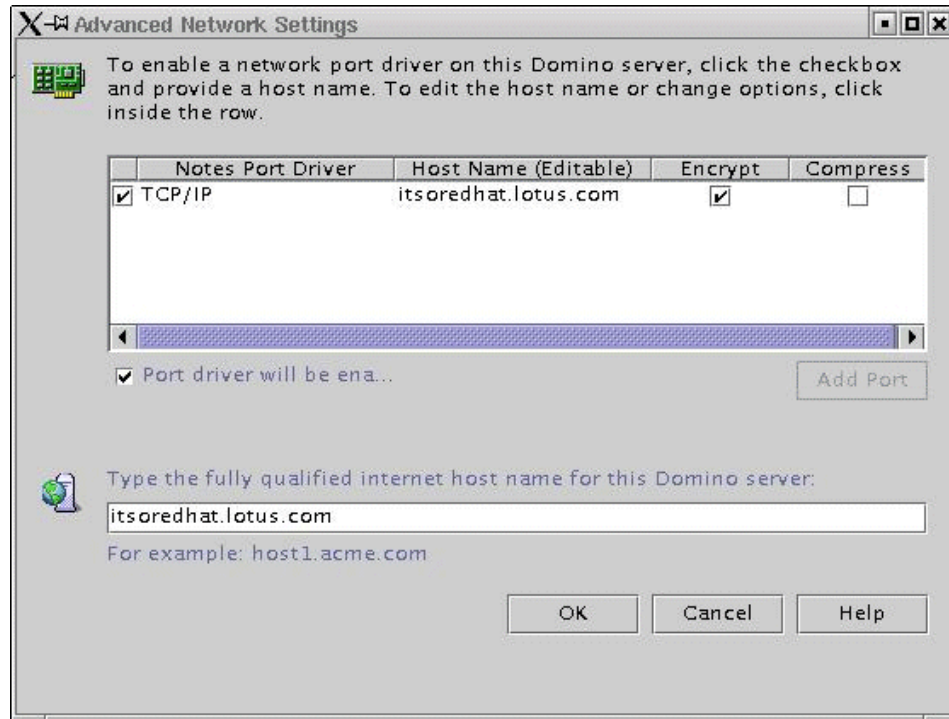


Figure 2-44 Domino advanced network settings

16. We checked “Encrypt” for the network traffic in order to guard against anyone “sniffing” the packets during transmission. For a WAN server with sufficient processing power and memory, we would have selected the “Compress” option instead. Click **OK**, then click **Next**.

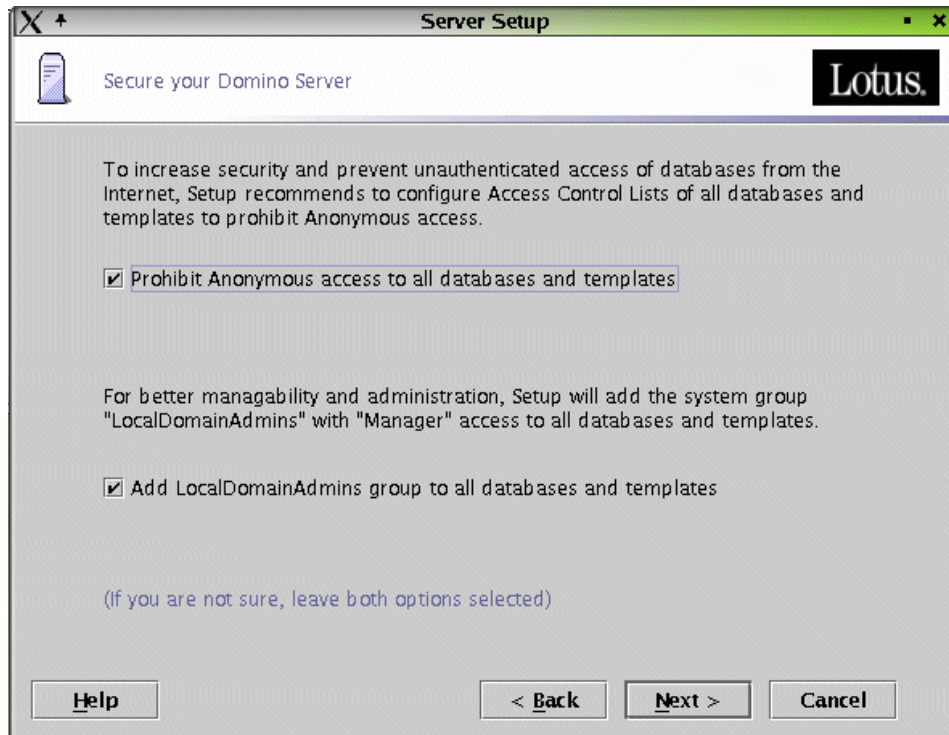


Figure 2-45 ACL settings

17. To increase security, ensure that the two security boxes in Figure 2-45 are checked (this is the default) and click **Next**.

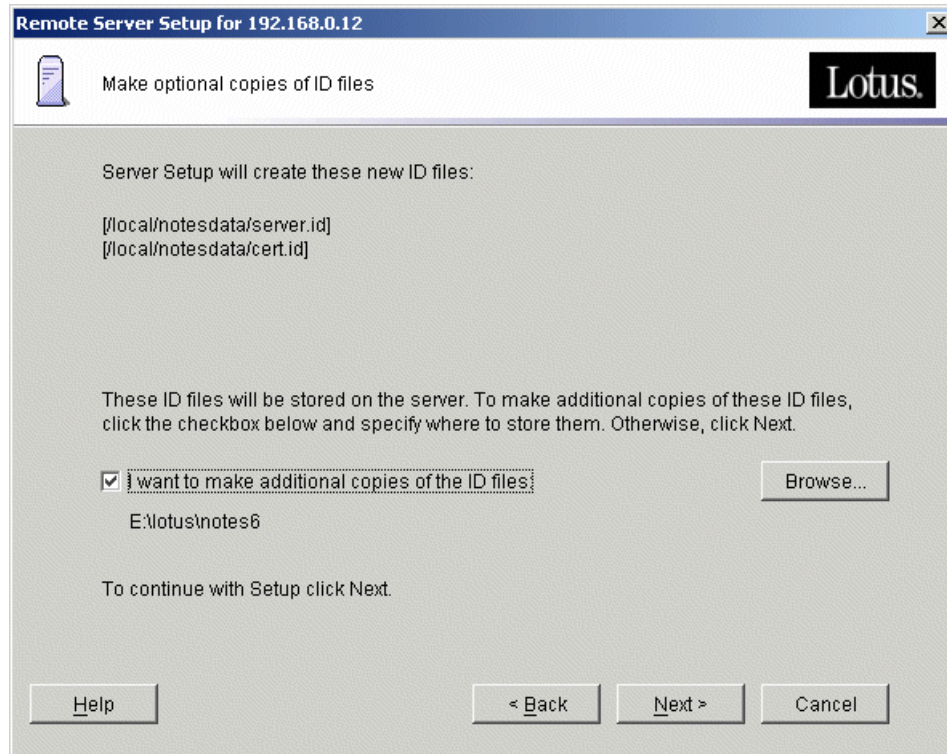


Figure 2-46 Copy ID files

18. The remote setup allows the server and certifier ID files to be copied to the local workstation.

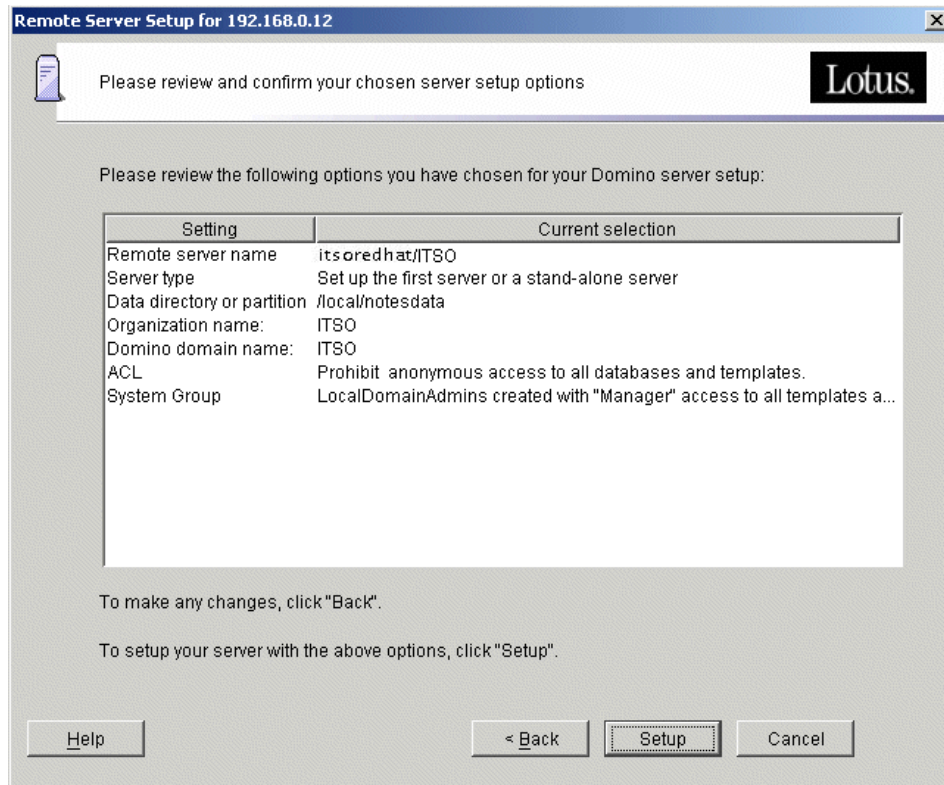


Figure 2-47 Remote server setup

19. When you are satisfied the information is correct, click **Setup** to finish the process.

Click **Yes** to stop the Domino server command in the listen mode (see Figure 2-48).



Figure 2-48 Stop the Domino server

## 2.2.6 Local setup

Running the setup locally on the server is slightly different than running the server remotely. The difference lies in the steps necessary to start the setup program. But once setup is running, the process is identical to the remote setup.

1. Log in as root to the graphical desktop environment of your choice. Most people use KDE or Gnome. Then add your server to the access control list of xhost. This will give permission to your server to send a display to your screen.

```
/usr/X11R6/bin/xhost <hostname>
```

2. Switch to the user account for Domino and set the DISPLAY environment variable to your local screen.

```
su - <Domino user>  
export DISPLAY=<hostname>:0
```

3. Make sure that you are located in the data directory and launch the server:

```
pwd  
/opt/lotus/bin/server
```

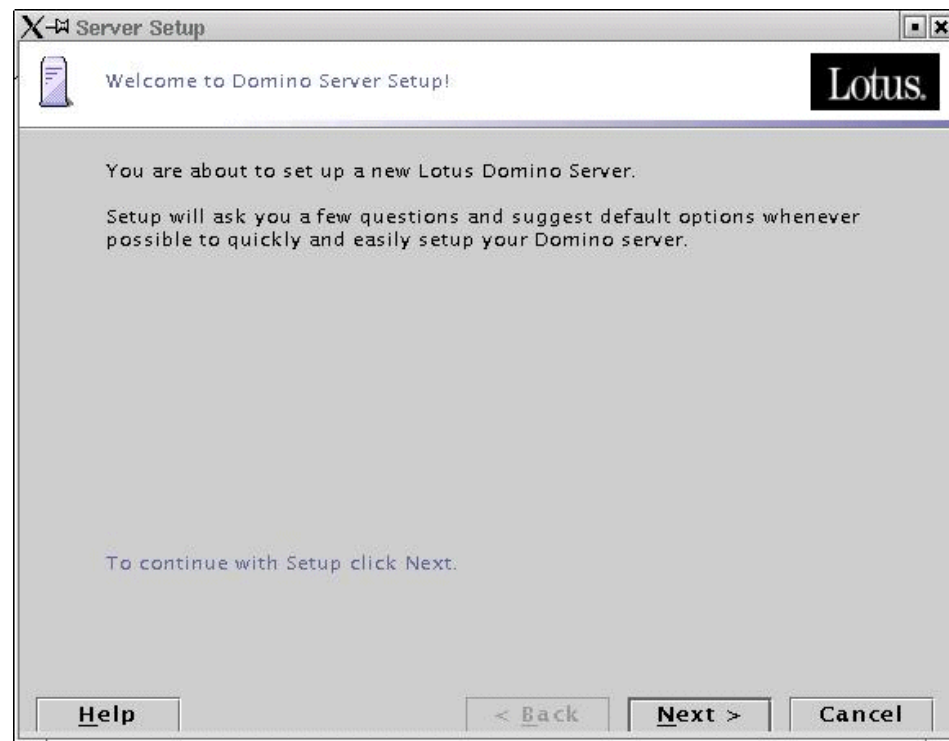


Figure 2-49 Domino 6 Welcome screen

4. The server will detect that the notes.ini is new and so will launch the Java Server Setup program. Click **Next** to continue. The rest of the steps are similar to those described in 2.2.5, “Remote setup” on page 107.

## Re-running the Domino server setup

If you need to re-run the setup from scratch, you can remove all lines from the notes.ini after the **CleanupScriptPath=** line.

This, of course, means you’ll lose all previously configured information and customized notes.ini settings.

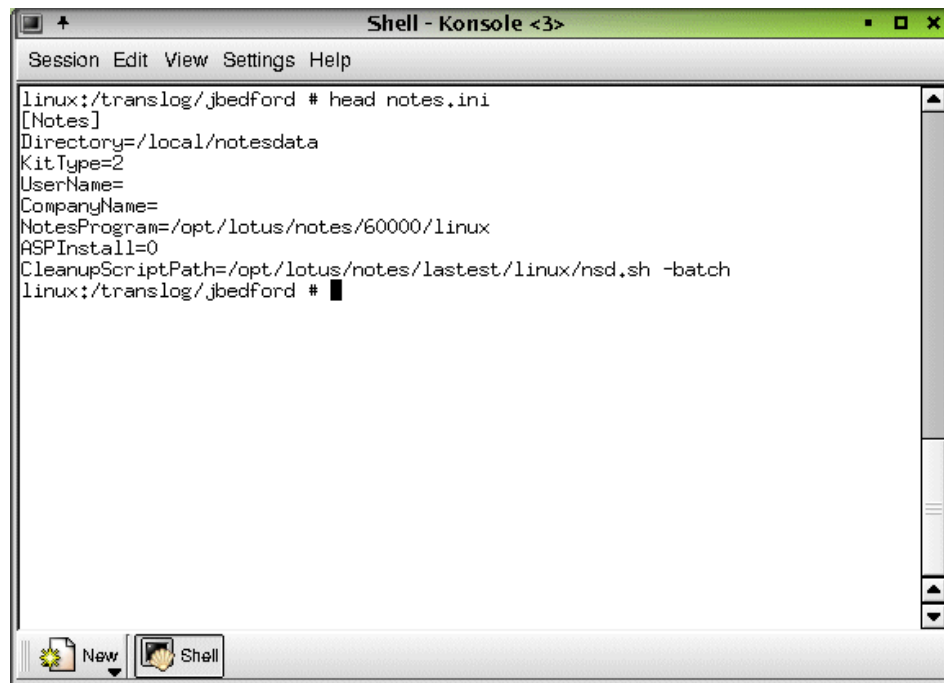


Figure 2-50 Re-running setup

## 2.2.7 Starting the Domino server

To start the server, launch a shell (refer to Figure 2-1 on page 84 for instructions), change to your Domino data directory (in our case it was the local/notesdata directory) and type **server** at the command prompt. If you have not customized your shell environment as shown in “Setting the Linux PATH environment variable” on page 105, you will need to supply the full path in order for Linux to locate the executable.

This will start the server in the foreground, and Domino will create the initial databases required for operation and for the enabled services. As with any Linux program running in the foreground, you will need to leave the shell window open until the program is complete. Normally, we append `&` to the command line to run the server in the background so that we can exit the shell and log off. The idea of a service in NT is a mirror of the UNIX concept of running a task in the background.

Once the initial tasks are finished and you have verified that there are no errors, type **quit** to exit the server so you can take a look at the new Java console.

## Java Domino console

To start the server with the new Java console, issue the following command:

```
server -jc &
```

This command will launch all three components: the Domino Server itself, the Domino Controller, and the Domino Console. For those of you familiar with the Win32 Domino Administration client, you will recognize the interface.

**Note:** Java Domino Console is new to Domino 6 and it replaces the **cconsole** that was the built in console program in Domino R5. The **cconsole** command is still available if you don't have access to a GUI system. See the *Lotus Domino R5 for Sun Solaris 8* redbook for more information on the **cconsole** command.



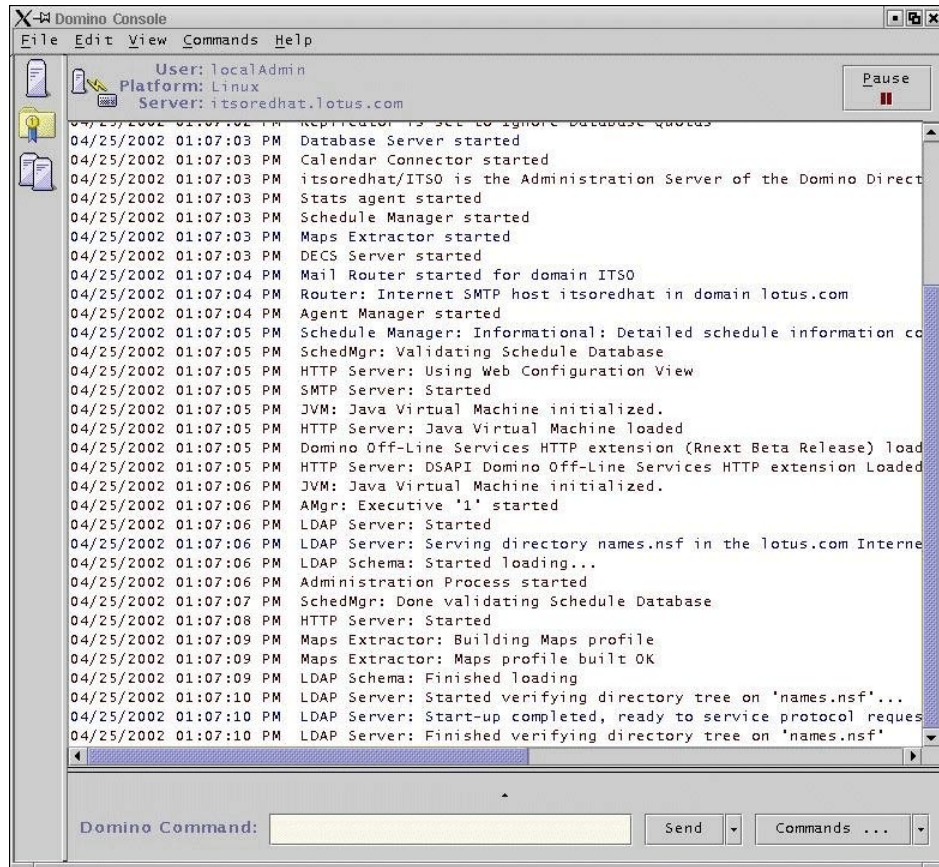



Figure 2-51 The new Domino console

Essentially, the Controller runs on the server and listens for connection requests from the Console. When it receives a connection request, it authenticates the connection using information that it has cached from the Domino Directory then allows access to the server and the Linux environment according to the rights granted in that particular server document.

In this case, we launched the Java console as part of the initial server startup and so were granted rights as a local administrator. However, you can start the Domino Console at any time, and it can be run locally or remotely.

To see how this works, go to **File -> Disconnect Controller** and disconnect from the server. Next, select **File -> Exit** to exit the Domino Console. Remember, if you type **exit** or **quit** at the Domino Console prompt, you will instead cause the Domino server to exit.

At this point, the Domino Console has quit, but the Domino Server and Controller are still running. If you would like to verify that the server is up, you can type **ps -A | grep server** (you can replace **server** with another Domino task, such as **replica**) at the shell command prompt. To see if the Domino Controller is still listening, type **netstat -a | grep 2050**. If you have changed the default port, you'll need to substitute the port you are using for 2050.



```
root@itsoredhat: ~ - Shell - Konsole
Session Edit View Settings Help
[root@itsoredhat root]# netstat -a | grep 2050
tcp 0 0 itsoredhat.lotus.c:2050 *:* LISTEN
[root@itsoredhat root]# ps -A | grep server
1988 ? 00:00:00 ksmsserver
4905 pts/2 00:00:03 server
4914 pts/2 00:00:00 server
4915 pts/2 00:00:00 server
4916 pts/2 00:00:07 server
```

Figure 2-52 **ps** and **netstat** output

**Tip:** When in doubt about what a Linux command does, for example **ps**, you can type **man ps** to view an on-line manual page. If you are uncertain what the command you need is, you can try **man -k <keyword>**. This will search the manual page descriptions for the keyword you specified.

From a shell, type **jconsole** to launch the Domino Console.

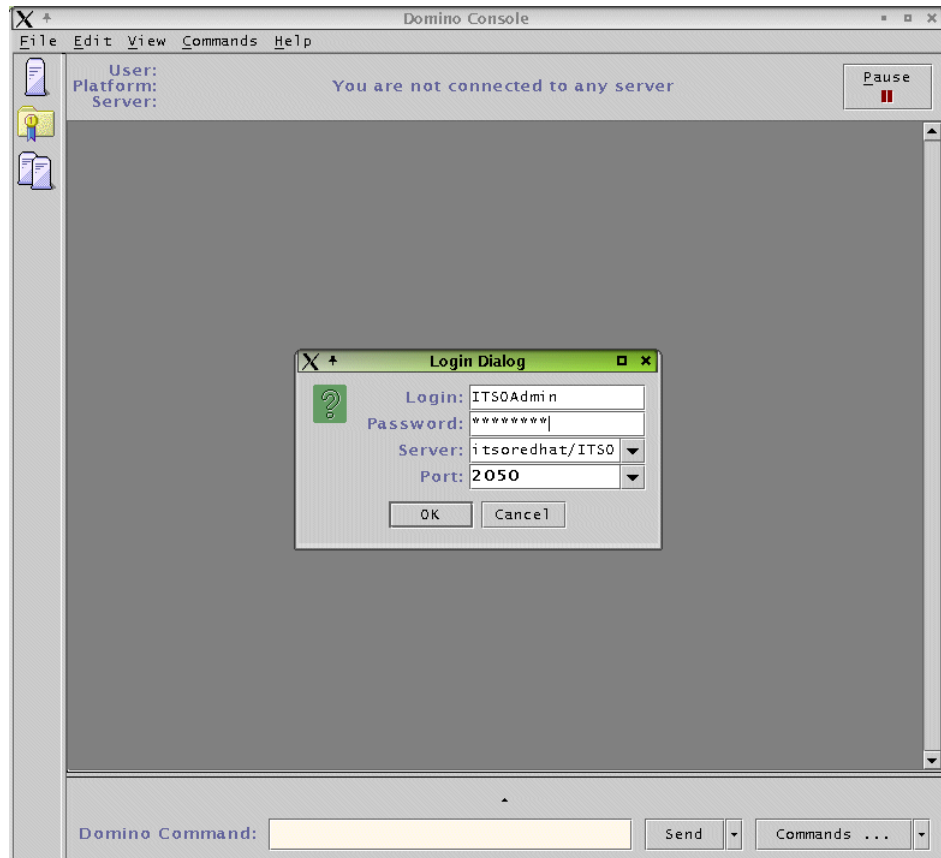


Figure 2-53 Connecting to the Domino server

Enter your Domino user name, password, and the name of the server to which you would like to connect. We connected to the same server, but you can use the Domino Console to connect to any Domino server for which you have administrator privileges.

The Administrator field located in the Domino Directory server document grants you the right to issue all Domino console commands, including **quit** and **restart** server, but does not allow the use of shell commands. This will allow you to carry out all normal Domino server administration, but should you desire additional rights, you could consider adding your username to the Full Access Administrators field in the Domino Directory. However, this field grants extensive rights and is not required for most administrative tasks. In general, only a single ID with multiple passwords should be entered into the Full Access Administrators field to protect the integrity of your domain.

Even when the Domino server has been shut down, you can start it again, as long as the Domino controller is still running. All the data between the jconsole and the controller is encrypted using SSL.

## Starting Domino from a script

We recommend that you start Domino from a script. This will ensure that the server is always started when the system is rebooted. Starting Domino via a script is akin to the *service* feature available with Windows NT. The advantage of a script over a pre-defined GUI is that you can configure the script to carry out specialized tasks, as well as start Domino in the manner best suited to your operating environment.

The startup script included here can be downloaded from the redbook website. See more information on how to acquire the script in Appendix B, “Additional material” on page 445.

To install this script on your Linux system:

1. Log in to the system as root.
2. From a shell command line, navigate to `/etc/init.d` (issue the command `cd /etc/init.d`)
3. Copy the Domino file from the website into this directory via ftp or ssh, or else create a new file with your favorite editor and paste the text of the script into it.
4. Once you have copied or saved the file—it should be named **domino**—you need to set the permissions and the owner. These should be the same as the other files in the `/etc/init.d` directory. This is usually root:root for the owner and group and -rwxr-xr-x for file permissions.

You can learn more about file permissions and ownership in “File permissions” on page 135.

5. Issue the command `chkconfig --add domino` to register the script with the Linux startup process.

Here is the startup script for Domino 6. Remember that this script assumes you will be using the performance enhancements described in 4.1.2, “Linux scalability” on page 208.

The **domino** startup script is meant to be run automatically during system startup. If you need to restart Domino without rebooting the entire system, use the **startserver** script, instructions how to obtain the script are included in the Appendix B, “Additional material” on page 445. The **startserver** script should be placed in the Domino data directory and given execute permissions as outlined in Step 4. However, the owner should be the Linux account used to run Domino and the script should be started by that account as well.

### Example 2-1

---

```
#!/bin/sh
# A startup script for the Lotus Domino 6 server
#
# chkconfig: 345 95 5
# description: This script is used to start the domino \
# server as a background process.\
#
# Usage /etc/init.d/domino start|stop
# This script assumes that you are using the performance tweaks
# detailed in the Domino 6 for Linux redbook and that these tweaks
# are stored in a directory called lib in the Domino Data directory.
# If you are not using these tweaks, you should replace the line starting with
# su - $DOM_USER -c "LD_PRELOAD...
# with the following line
# su - $DOM_USER -c "$DOM_PROG/server -jc -c" > /dev/null 2>&1 &

# You should change the 3 following variables to reflect your environment.

# DOM_HOME is the variable that tells the script where the Domino Data resides
DOM_HOME=/local/notesdata

# DOM_USER is the Linux account used to run the Domino 6 server
DOM_USER=notes

# DOM_PROG is the location of the Domino executables
DOM_PROG=/opt/lotus/bin

start() {
    echo -n "Starting domino: "
    if [ -f $DOM_HOME/.jsc_lock ]; then
        rm $DOM_HOME/.jsc_lock
    fi
    su - $DOM_USER -c
    "LD_PRELOAD=$DOM_HOME/lib/libpthread.so.0:$DOM_HOME/lib/librt.so.1;export
    LD_PRELOAD;$DOM_PROG/server -jc -c" > /dev/null 2>&1 &
    return 0
}

stop() {
    echo -n "Stopping domino: "
    su - $DOM_USER -c "$DOM_PROG/server -q"
    return 0
}

case "$1" in
```

```
start)
    start
;;
stop)
    stop
;;
*)
    echo "Usage: domino {start|stop}"
    exit 1
esac
```

---



## Security and administration

In this chapter, we describe the basics of Linux and Domino security and what you can do to achieve an appropriate level of security. We touch on physical, system, and network security for Linux, then discuss partitions, scripts, and scheduling jobs. For Domino, we review steps you should take to secure your new server, then discuss the enhanced Web administration client and the new Domino Controller available with Domino 6.

## 3.1 Linux security

In this section, we focus on security at the OS level. After you install the OS, the first step is to secure your server so you will not install subsequent applications on an already compromised server.

Because of expanding global communications and internet connectivity, more and more people have access to your servers, and not all of these people have good intentions. Therefore, you need to protect your servers from attacks and at the same time grant access to those who need it. Keep in mind that no server, regardless of the OS, is completely secure; all you can do is make it increasingly difficult for someone to compromise your servers.

The levels of security that we discuss in this chapter are:

- ▶ Physical security
- ▶ System security
- ▶ Network security
- ▶ Backup security

### 3.1.1 Physical security

The first step in securing your server is limiting physical access to the machine. Consider all of the following:

- ▶ Lock the server in a special room to which only administrators have access.
- ▶ Lock the server console with a password.
- ▶ Lock your case. This way no one has easy access to the inside of your computer. Otherwise, someone could insert another hard drive, boot from it, and potentially gain access to the other drives in the system.
- ▶ Secure the floppy and CD-ROM. After you install all the software, consider removing the floppy and CD-ROM from the BIOS boot list.
- ▶ Lock the BIOS setup utility with a password.

**Attention:** If you enable a power-on password in BIOS, then your system will no longer reboot automatically in the event of a power failure.

### 3.1.2 System security

Not every user on the system needs root access. Though it is easier to work as root, you should grant root access only to those administering the server. If a user does not need access to a resource, you are better off not granting access.



## File permissions

In Linux almost every resource (files, directories, symbolic links, disks, modems, and so forth) is considered a *file*, and file permissions give access to the resource. From a shell, you can view the permissions of a file if you issue the command `ls -l` at the command line, as shown in Example 3-1.

*Example 3-1 Example of file permissions for /etc/passwd*

---

```
# ls -l /etc/passwd
-rw-r--r-- 1 root  root   873 Apr  4 15:27 /etc/passwd
```

---

This command gives the long listing format of the file `/etc/passwd`. In addition to the name of each file, it prints the file type, permissions, number of hard links, owner name, group name, size in bytes, and time stamp (by default this is the modification time). The type and the permission is the cryptic string of letters and dashes at the beginning of the line. The first character of the 10 character long code is the type of the file; in this case it is a dash which means this is a plain file. The possible file types are:

- Plain file
- d Directory
- l Symbolic link (like a Windows shortcut)
- b Block device (drives)
- c Character device (terminals, modems)

The next nine characters describe the permissions on the file. They are organized in groups of three. The first group gives the permissions of the owner of the file (in this case the user `root`), the second the permissions of the group (in this case the group `root`), and the last three characters give the permissions for any other user on the system.

A group of three characters is built as follows:

- ▶ First character is an `r` which means permission to read the file.
- ▶ Second is a `w` which stands for write permission.
- ▶ The last character is `x` for execute rights on a program or list rights if the file is actually a directory. Also `s`, `S`, `t`, and `T` are possible values for this character, but these permission are less frequent and beyond the scope of this book.

In our example, the permissions `-rw-r--r-- root root` mean read and write access for the user `root`, read rights for anyone who is a member of the group `root`, and read rights for any other user on the system.

On a Linux system, ordinary users only have write access to their \$HOME directory (also known as ~) and the /tmp directory. This is different than on Windows NT systems, where every user has access to all the disks except where access has been specifically denied. Since the Domino server runs as an ordinary user under Linux, you have to be sure that ownership of files and directories is set correctly.

For example, if you want to enable transaction logging, you have to make sure that the directory where the logs are stored is owned by the user who runs the Domino server. Let's say the disk that will contain the transaction log files is mounted under the directory /translogs. The ownership of this file, if created during installation, is root.root, so we have to change it. Log in as root, go to the top level directory (the / directory), and change the ownership as follows with the **chown** command:

```
# chown itsodom6.notes translogs
```

The user itsodom6, which is the user who runs the Domino server in our example, is now the owner of the directory /translogs. This makes it possible to enable transaction logging for Domino.

## Passwords

Passwords are an ubiquitous means of security, and every company should determine and set password rules based on their security requirements.

Each password has to be chosen with care. There are two components of password strength:

- ▶ Quantity - This is simply a minimum number of characters required before a password is acceptable.
- ▶ Quality - This is a more complex requirement that dictates the password must contain a combination of lower and uppercase letters, numbers, or other symbols.

In Linux, the default password length is five, but there is also a maximum length of eight. However, this can and should be changed. Linux offers a range of options to guard against weak passwords and we detail a number of them in this section. There are also many printed references, as well as Linux websites.

### ***Password settings in SuSE 8.0***

SuSE 8.0 has a tool for system administration that is like the Control Panel in Windows: Yet another Setup Tool (YaST2). This tool can be used either in text mode or in graphical user mode.

**Note:** You have to be logged in as root to have access to all areas of YaST2.

To quickly change the password settings, you can use the graphical YaST2. Click **Start Application -> System -> YAST2**, click **Security and Users**, then **Security Settings** as shown in Figure 3-1.

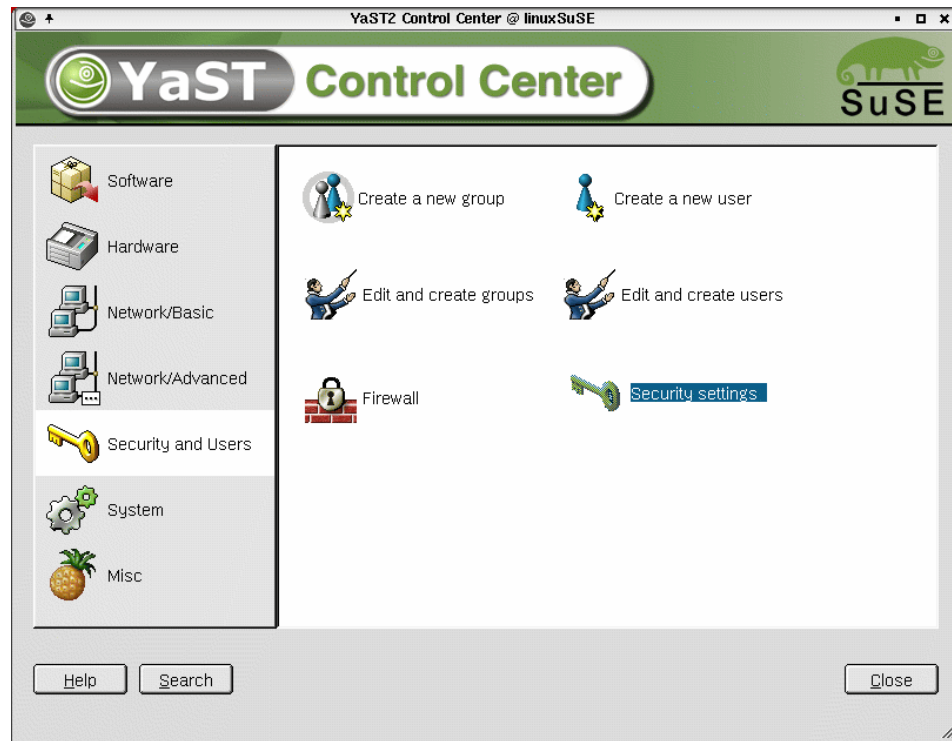


Figure 3-1 Security settings in SuSE 8.0

Check **Custom Settings** and click **Next** to display the Password settings window. You have a number of options regarding passwords. Here are our recommendations, shown in Figure 3-2 on page 138.

- ▶ Enable “Checking new passwords.”
- ▶ Enable “Plausibility test for password.”
- ▶ Enable “Activate MD5 encryption for passwords.”

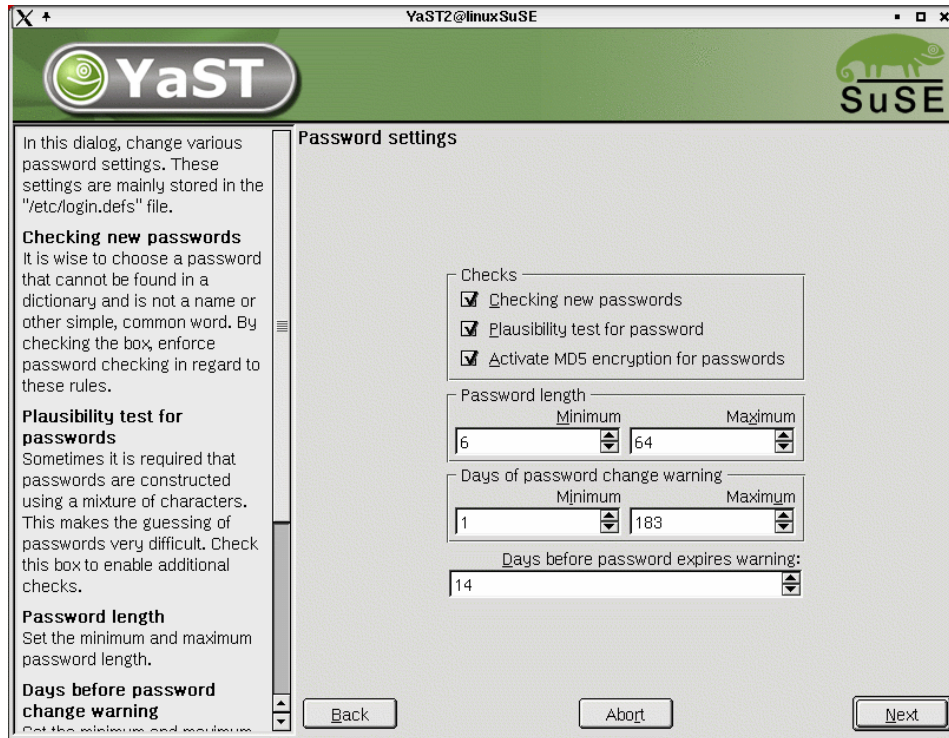


Figure 3-2 Password settings

There are a lot of opinions regarding minimum password length; the consensus seems to be that the password length should be at least six characters but seven and eight are also recommended. The root password should certainly be eight or more characters in length. Table 3-1 on page 139 shows different password lengths and the respective total possibilities if no restrictions are in place. As you can see, the use of just lowercase letters in a password seriously reduces the number of possible combinations.

In addition to minimum length, you should also change the maximum length to a much higher number than 8; we opted for 64 as shown in Figure 3-2.

Table 3-1 Password length and total possibilities

Password length	Combinations using lowercase letters (26)	Combinations using letters, numbers, and special characters (94)
5	11,881,376	7,339,040,224
6	308,915,776	689,869,781,056
7	8,031,810,176	64,847,759,419,264
8	208,827,064,576	6,095,689,385,410,816

Next, you should require your users to change their passwords periodically. Remember, however, that if you make users change their password too often or you require too many characters for the minimum password, it will often result in the user writing down the password, thereby defeating your overly stringent security measures. Twice a year seems a reasonable compromise, so we set the Maximum for “Days of password change warning” to 183.

**Attention:** During our use of YaST2, the “Days of password change warning” was not set correctly. You can verify that your changes have been saved by viewing the `/etc/login.defs` file, as detailed in “Password settings in Red Hat 7.2” later in this section.

You can then click **Next** to view the remaining security options. We elected to use the default settings, which include a three second log-in delay for failed attempts and a record of each failed attempt.

**Tip:** If you want to increase security even further, investigate switching to Kerberos authentication. There are many sources to learn more about Kerberos, for example, the Kerberos pages of MIT at:

<http://web.mit.edu/kerberos>

Another good source is the Linux Security HOW-TO, which you can find along with numerous other helpful documents at the Linux Documentation Project website at:

<http://tldp.org/docs.html>

### ***Password settings in Red Hat 7.2***

For Red Hat 7.2, log in as root and modify the `/etc/login.defs` file directly using KATE, as shown in Example 3-2 on page 140.

If your company already has a Linux security policy, make certain to utilize it in conjunction with our recommendations.

*Example 3-2 /etc/login.defs file*

---

```
# Password aging controls:
#
#      PASS_MAX_DAYS   Maximum number of days a password may be used.
#      PASS_MIN_DAYS   Minimum number of days allowed between password
changes.
#      PASS_MIN_LEN     Minimum acceptable password length.
#      PASS_WARN_AGE   Number of days warning given before a password expires.
#
PASS_MAX_DAYS   183
PASS_MIN_DAYS    0
PASS_MIN_LEN     6
PASS_WARN_AGE   14
```

---

Next, you can type **setup** at the command prompt to verify that you have enabled MD5 passwords.

1. Select **Authentication Configuration** by pressing Enter.
2. Use the Tab key to navigate to the **Next** option and press Enter. This will display the screen shown in Figure 3-3 on page 141.
3. Make certain that both “Use Shadow Passwords” and “Use MD5 Passwords” are selected. (You can use the spacebar to select and deselect options.)
4. Press Tab until **OK** is highlighted; press Enter to accept.
5. Quit the **setup** program.

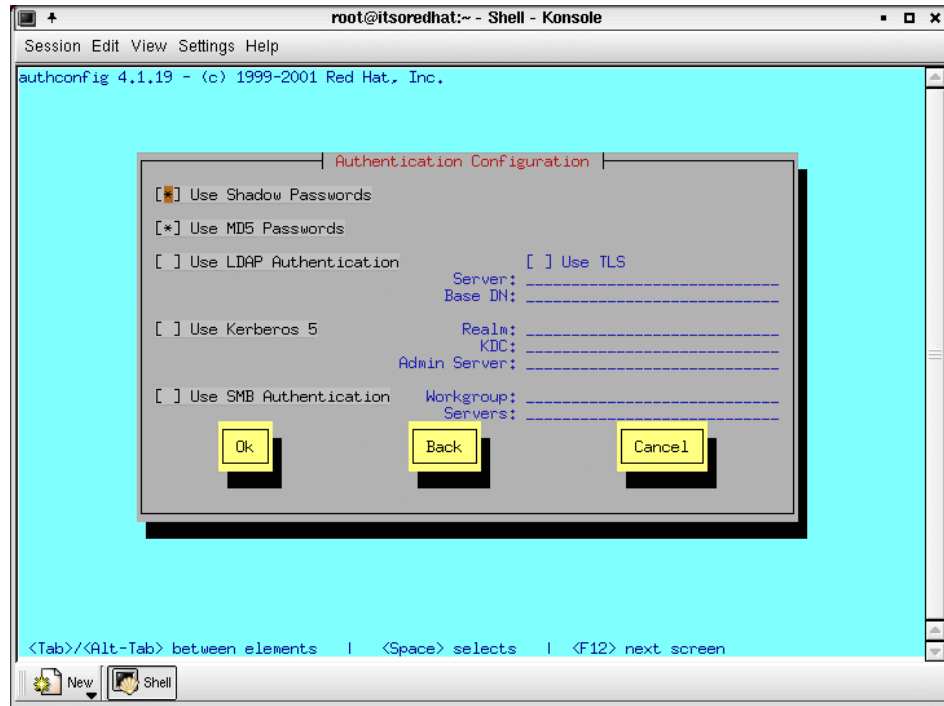


Figure 3-3 Authentication Configuration for Red Hat 7.2

## Network security

In this section, we cover both basic and advanced network security. For more information, visit the following Web site:

<http://www.linuxsecurity.com>

### Basic network security

In the UNIX system world, software that is able to connect to (exchange information with) other software on the same system or another system is called a daemon. Usually, the daemon listens on a specified IP and port; the Domino server listens on port 1352. A server normally has many daemons running at the same time, such as the ftp daemon, telnet daemon, and so forth. Through these daemons, another system can connect to the server and exchange information.

Daemons are divided into two categories: those started by root user; and the rest, started by other users. The daemons started by root listen on ports below 1024.

If a daemon has a programming “bug” or there is an unusual circumstance, such as information coming too fast for the daemon to handle or reception of a

command it should not receive, the daemon may crash. When a daemon crashes, it often returns a prompt without requesting a password and whoever was connected at that time with the daemon now has the prompt. If the daemon was started by root, then when it crashes, it returns a root prompt, which is very dangerous. Minimizing the number of daemons run by root is an important step in securing your server.

After the installation of Linux, there are many ports open by default because a number of daemons are automatically started. To increase security, as well as performance, you should stop daemons that you do not need.

In Table 3-2, we explain some of the frequently used services available for Linux. On a Domino server, you will not need to run many of these daemons. In the table, the column labeled **Enable?** indicates whether or not we recommend this daemon for a Linux Domino 6 server.

**Tip:** You can always enable a service, such as **ftpd**, when you need to transfer files and then disable it when you are done.

Table 3-2 Linux daemons

Name of the service	Enable?	Observations	Port
crond	Yes	It runs user-specified programs at periodically scheduled times. It is useful for log rotation, for example.	N/A
ftpd	No	This is an ftp (file transfer protocol) daemon common on SuSE. Use it to move files from one server to another. You can use the <b>scp</b> command with an SSH shell.	21
gpm	Yes	It adds mouse support to a text console.	N/A
httpd	No	Linux web server.	80
ipchains	No	Firewall tool.	N/A
iptables	No	Firewall tool.	N/A
keytable	Yes	It loads the selected keyboard map.	N/A
kudzu	No	This runs a hardware probe akin to plug and play. After you install your server hardware, you can turn this off.	N/A
lpd	No	Print daemon.	515



Name of the service	Enable?	Observations	Port
network	Yes	Activates/Deactivates all network interfaces configured to start at boot time.	
nfs	No	A file sharing protocol across TCP/IP.	2049
sendmail	No	An SMTP server.	25
snmpd	No	A management protocol. You should enable this daemon only if you have implemented SNMP.	161
ssh	Yes	A secure shell for remote administration. Use it to remotely administer the server from a shell.	22
syslog	Yes	The facility by which many daemons log messages to various system files.	N/A
telnet	No	A shell for remote administration. Use SSH for secure remote administration.	23
wu-ftpd	No	An ftp (file transfer protocol) daemon common on Redhat. Use it to move files from one server to another. You can use the <b>scp</b> command with an SSH shell.	21
xfs	Yes	The X Font Server.	N/A
xinetd	Yes	Runs other daemons on demand.	N/A

### ***Starting and stopping daemons***

Starting and stopping daemons can be done by logging in as root to KDE and launching the SysV - Init Editor by selecting **Start Application -> System -> Configuration -> SysV Init Editor** on SuSE or **Start Application -> System -> SysV Init Editor** on RedHat. (See Figure 3-4 on page 144.)

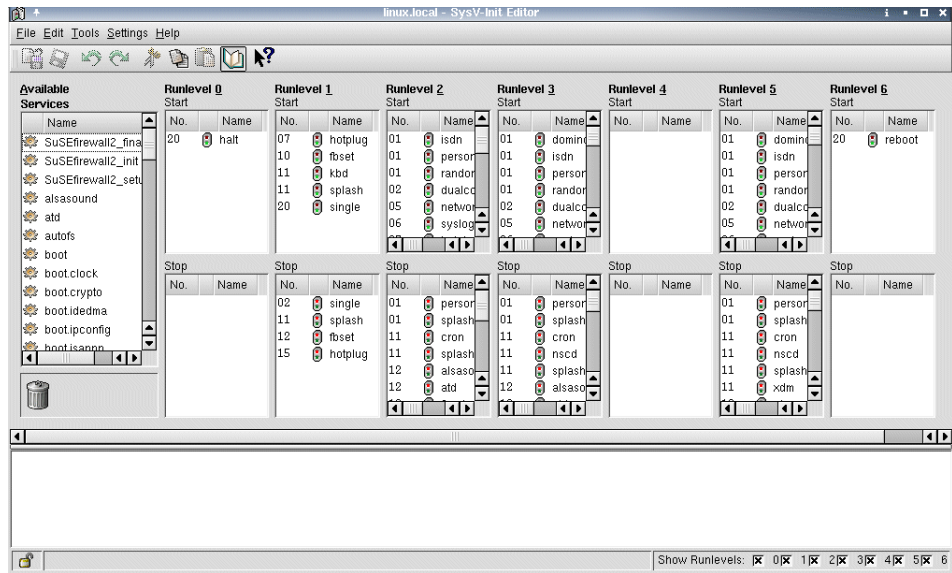


Figure 3-4 SysV Init Editor

Before using the SysV Init Editor you should first understand runlevels. Windows really has only two runlevels: *Recovery* and *Normal*. *Recovery* is only used when there is a problem with the system. Most of the time Windows runs in *Normal* mode.

Linux usually has six runlevels. Runlevel 0 is used to shut down the server; runlevel 6 is used to restart the server. Runlevel 1 (Single user mode) is used like the Windows recovery mode. Most systems normally run at runlevel 3 (command line) or runlevel 5 (X-Windows).

The top row of boxes in Figure 3-4 shows the services that will start when the system enters each runlevel, the bottom row of boxes show what services will be stopped when the system enters that runlevel.

**Note:** A service should *not* appear in both the Start and Stop boxes for a runlevel.

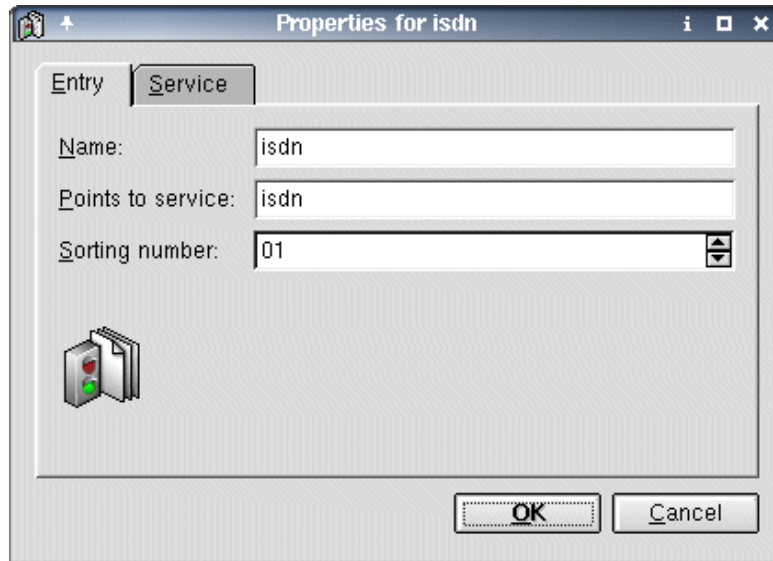


Figure 3-5 Properties for a service

To stop/start a service, click on the service (see Figure 3-5) and then go to the Service tab and click the **Start** or **Stop** button (see Figure 3-6 on page 146).

To prevent a service from starting when entering a runlevel, drag and drop the service from the runlevel to the Trashcan.

To start a service when entering a runlevel, drag and drop the service from the Available Services list to the start box of the appropriate runlevel.

To stop a service when entering a runlevel, drag and drop the service from the Available Services list to the start box of the appropriate runlevel.

**Tip:** It is a good idea to have the Domino service in the stop boxes for runlevels 0 and 6. This ensures that the Domino server shuts down cleanly when the system is shut down or rebooted.

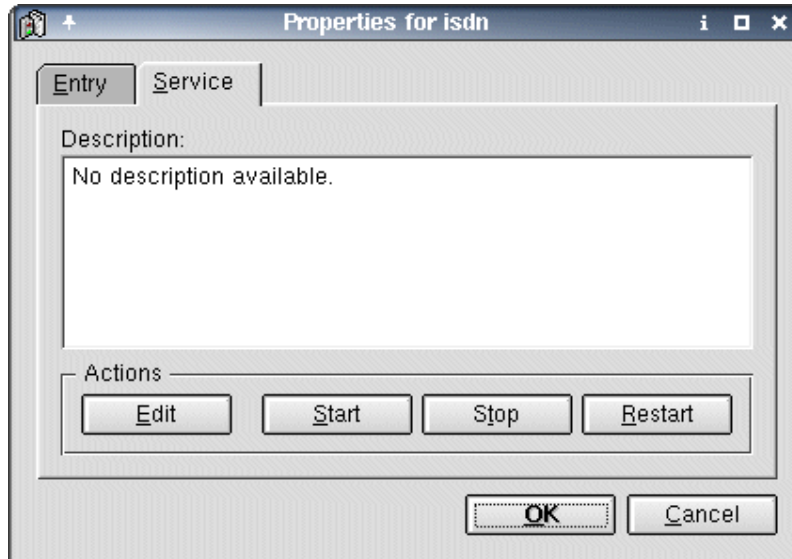


Figure 3-6 Start/Stop a service

### **Showing running daemons**

To see what daemons are listening (accepting connections) on your server, log in as root and issue the command `netstat -a | grep "LISTEN "` as shown in Figure 3-7. In this way, you can always check to see if your daemons are listening.

**Note:** Linux is case-sensitive, so LISTEN must be upper case in this example.

```
Session Edit View Settings Help
itsosuse:~ # netstat -algrep "LISTEN "
tcp        0      0 *:7937          *:*           LISTEN
tcp        0      0 *:7938          *:*           LISTEN
tcp        0      0 *:x11           *:*           LISTEN
tcp        0      0 *:9616          *:*           LISTEN
tcp        0      0 *:25680         *:*           LISTEN
tcp        0      0 *:9617          *:*           LISTEN
tcp        0      0 *:9618          *:*           LISTEN
tcp        0      0 *:9619          *:*           LISTEN
tcp        0      0 *:ftp           *:*           LISTEN
tcp        0      0 *:ssh           *:*           LISTEN
itsosuse:~ #
```

Figure 3-7 `netstat -a | grep "LISTEN "` command output

### Securing daemons

If you need a daemon to run and want to control who can connect to your machine and who can't, use the files `/etc/hosts.allow` and `/etc/hosts.deny`.

In the file `/etc/hosts.allow`, you can set who *can* connect to your machine on different ports, as shown in Example 3-3.

#### Example 3-3 The `/etc/hosts.allow` file

```
# cat /etc/hosts.allow
sshd: 192.168.1.0/255.255.255.0
sshd: 192.168.234.0/255.255.255.0
in.ftpd: 192.168.0.0/255.255.0.0
```

This means only clients with an IP address between 192.168.1.1 and 192.168.1.254 or 192.168.234.1 and 192.168.234.254 can connect to the **ssh** server, while only those with an IP address between 192.168.0.1 and 192.168.255.254 can connect to your **ftp** server.

In the file `/etc/hosts.deny`, you can set who is *not* allowed to connect to your machine on different ports, as shown in Example 3-4.

#### Example 3-4 The *hosts.deny* file

---

```
# cat /etc/hosts.deny
sshd: 10.10.10.0/255.255.255.0
in.ftpd: 10.10.99.0/255.255.255.0
```

---

This means clients between 10.10.10.1 and 10.10.10.254 cannot connect to the **ssh** server, while clients between 10.10.99.1 and 10.10.99.254 cannot connect to the **ftp** server.

**Tip:** For best security practices the */etc/hosts.deny* should contain all: *all deny*. This means that nobody can connect to the daemons protected by *tcpd* (see *man tcpd*) unless they are in the */etc/hosts.allow*.

**Tip:** Use the **ssh** daemon instead of the **telnet** daemon because SSH encrypts all the data between your client and server. You will need an SSH client if working from a Windows machine; you can find one free, such as the versatile PuTTY and its companion product PSCP (PuTTY Secure Copy), on the Internet. A good use of PSCP is to copy the *cert.id* file from the Domino server to a workstation. For more information, see:

<http://www.chiark.greenend.org.uk/~sgtatham/putty>

#### **Advanced network security**

If you want to remotely administer servers in a very secure manner, use a different physical network if possible. In other words, use different network adapters and different switches.

**Note:** The administrative network does not have to be a high speed network. You can use older hubs or switches.

If you create a separate network for administration, you will have the following advantages:

- ▶ You don't have to worry about someone stealing your password.
- ▶ You can update your software through the administration network so your client will not notice a performance decrease.
- ▶ In case your high speed network fails, you can use the administrator network for a short period of time.

## Firewalls

To increase the security of the internal network and to protect servers from anyone who tries to steal or destroy your data, we recommend that the network and the servers be connected to the Internet through a firewall system. *Firewall* software is a network filter between your network and the Internet. All traffic to and from the Internet should pass through at least one firewall. For example, the firewall software is responsible for stopping all the requests coming in to your servers that are not addressed to the servers, and to stop some of the requests if the server cannot handle all the requests (also called flooding).

We recommend that you implement a firewall system in your network to protect your data. Figure 3-8 is a simple illustration, where the network is separated in two. One segment, typically referred to as a DMZ, has servers that need special access to the Internet. The second network is the internal LAN, where the most important data resides.

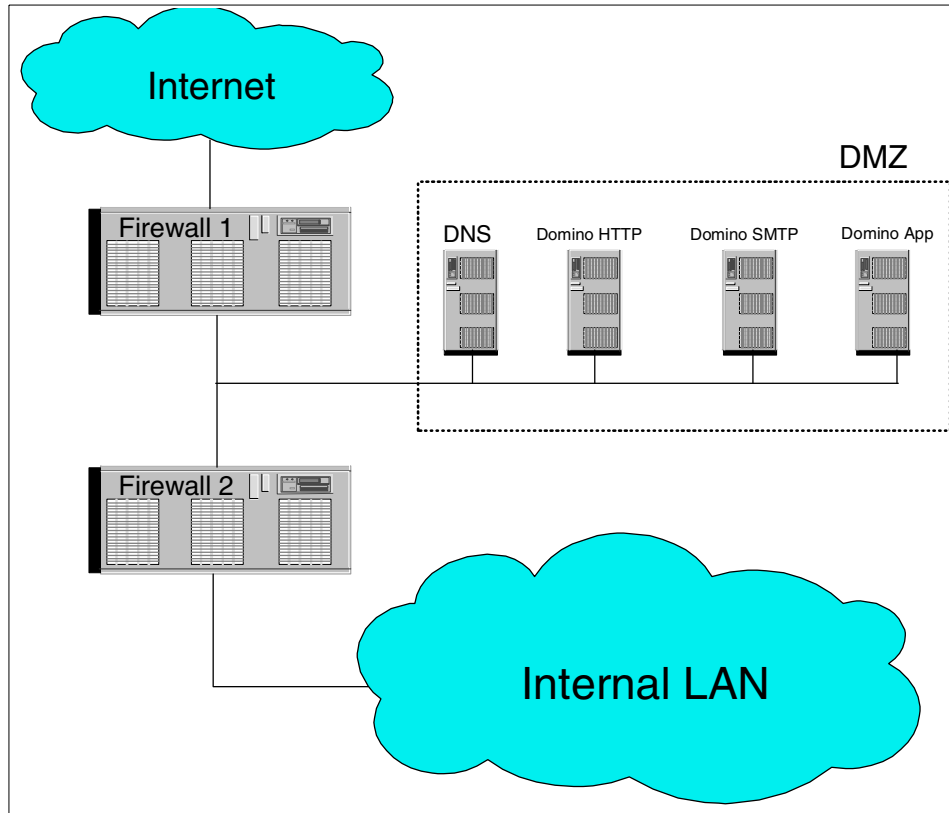


Figure 3-8 Firewall system

There are commercial firewall solutions and open source firewall solutions. Linux has a firewall solution that is very secure and very fast: iptables/netfilter. Some of its features are the following:

- ▶ Packet filtering
- ▶ Content filtering
- ▶ MAC address filtering
- ▶ NAT (Network Address Translation)
- ▶ Anti-flooding procedures
- ▶ Many, many other features

**Note:** For more information about **netfilter**, refer to the following website:

<http://netfilter.samba.org>

## Backup security

Another method to gain access to your information is by stealing your backup tapes. In this way, it is possible for someone to read your information, but not to modify it.

There are two ways to back up your server:

- ▶ A tape or a library directly attached to your server
- ▶ A backup server with a tape or library attached to it

Make certain to lock your tapes in a safe place, and if you are using a backup server, be sure to use a username and a password to back up or restore your files. See “Backup” on page 425 for more information about backing up your data and about different backup solutions.

## Operating system patches

Both SuSE and RedHat provide easy ways to keep you system up-to-date with the latest security patches. See YaST2 for SuSE and RHN (RedHat Network) RedHat for more information.

# 3.2 Linux administration

It is not difficult to administer a Linux server. In this section, we discuss basic administrative tasks, such as creating a partition, creating a file system, creating scripts, and modifying **crontab**.



## 3.2.1 Partitions

The tool to create, erase, or modify a partition is **fdisk**. To be able to use it, log in as root to a shell and type **fdisk /dev/sda**, where sda is the first SCSI hard disk. If you are not using SCSI, then the first hard disk will be hda. To list the partitions on a SCSI hard disk, type **fdisk /dev/sda -l** as shown in Example 3-5.

*Example 3-5 The partition list*

---

```
# fdisk /dev/sda -l

Disk /dev/sda: 240 heads, 63 sectors, 2584 cylinders
Units = cylinders of 15120 * 512 bytes

    Device Boot      Start         End      Blocks   Id  System
/dev/sda1   *           1           821     6206728+    7  HPFS/NTFS
/dev/sda2             822        2584     13328280    f  Win95 Ext'd (LBA)
/dev/sda5          1365        2584     9223168+    b  Win95 FAT32
/dev/sda6           822        1329      3840417   83   Linux
/dev/sda7          1330        1364      264568+   82   Linux swap
```

Partition table entries are not in disk order

---

**Important:** Your disk partitions will likely be different from the example.

Linux has the following partition numbering system:

- From 1 to 4 are primary partitions
- From 5 to 16 are logical partitions

To view all **fdisk** commands, start **fdisk** interactively with **fdisk /dev/sda**, then type **m** as shown in Example 3-6.

*Example 3-6 List of commands*

---

```
Command (m for help): m
Command action
 a   toggle a bootable flag
 b   edit bsd disklabel
 c   toggle the dos compatibility flag
 d   delete a partition
 l   list known partition types
 m   print this menu
 n   add a new partition
 o   create a new empty DOS partition table
 p   print the partition table
```

```
q  quit without saving changes
s  create a new empty Sun disklabel
t  change a partition's system id
u  change display/entry units
v  verify the partition table
w  write table to disk and exit
x  extra functionality (experts only)
```

---

To delete a partition, follow Example 3-7.

*Example 3-7 Deleting a partition*

---

```
Command (m for help): d
Partition number (1-7): 7
```

```
Command (m for help):
```

---

To create a logical partition, follow Example 3-8.

*Example 3-8 Creating a partition*

---

```
Command (m for help): n
Command action
  l   logical (5 or over)
  p   primary partition (1-4)
l
First cylinder (1330-2584, default 1330):
Using default value 1330
Last cylinder or +size or +sizeM or +sizeK (1330-1364, default 1364):
Using default value 1364
```

```
Command (m for help):
```

---

**Note:** The logical option will only appear for a new partition if an extended partition has already been created.

After you have created a partition, you may change the partition's type. In Linux the partition type is coded as a number or id. By default, Linux creates a partition with id 83, which mean it is designated as a Linux partition.

In Example 3-9 on page 153, you can see all the partition types supported by Linux at this time.

### Example 3-9 All partition types supported by Linux

Command (m for help): t

Partition number (1-7): 6

Hex code (type L to list codes): l

0	Empty	1b	Hidden Win95 FA	64	Novell Netware	bb	Boot Wizard hid
1	FAT12	1c	Hidden Win95 FA	65	Novell Netware	c1	DRDOS/sec (FAT-
2	XENIX root	1e	Hidden Win95 FA	70	DiskSecure Mult	c4	DRDOS/sec (FAT-
3	XENIX usr	24	NEC DOS	75	PC/IX	c6	DRDOS/sec (FAT-
4	FAT16 <32M	39	Plan 9	80	Old Minix	c7	Syrinx
5	Extended	3c	PartitionMagic	81	Minix / old Lin	da	Non-FS data
6	FAT16	40	Venix 80286	82	Linux swap	db	CP/M / CTOS / .
7	HPFS/NTFS	41	PPC PReP Boot	83	Linux	de	Dell Utility
8	AIX	42	SFS	84	OS/2 hidden C:	df	BootIt
9	AIX bootable	4d	QNX4.x	85	Linux extended	e1	DOS access
a	OS/2 Boot Manag	4e	QNX4.x 2nd part	86	NTFS volume set	e3	DOS R/O
b	Win95 FAT32	4f	QNX4.x 3rd part	87	NTFS volume set	e4	SpeedStor
c	Win95 FAT32 (LB	50	OnTrack DM	8e	Linux LVM	eb	BeOS fs
e	Win95 FAT16 (LB	51	OnTrack DM6 Aux	93	Amoeba	ee	EFI GPT
f	Win95 Ext'd (LB	52	CP/M	94	Amoeba BBT	ef	EFI (FAT-12/16/
10	OPUS	53	OnTrack DM6 Aux	9f	BSD/OS	f1	SpeedStor
11	Hidden FAT12	54	OnTrackDM6	a0	IBM Thinkpad hi	f4	SpeedStor
12	Compaq diagnost	55	EZ-Drive	a5	BSD/386	f2	DOS secondary
14	Hidden FAT16 <3	56	Golden Bow	a6	OpenBSD	fd	Linux raid auto
16	Hidden FAT16	5c	Priam Edisk	a7	NeXTSTEP	fe	LANstep
17	Hidden HPFS/NTF	61	SpeedStor	b7	BSDI fs	ff	BBT
18	AST SmartSleep	63	GNU HURD or Sys	b8	BSDI swap		

Hex code (type L to list codes):

After you create a partition and set its type, press **w** to commit the changes to the hard disk drive.

**Attention:** The changes you make to partitions are not committed until you press **w**, so in case of a mistake, press **q** to exit without saving your changes.

## 3.2.2 File systems

With the partition created, you can format it and create a file system for it. To do so, you have to choose how you will format it. For a Linux partition, you can choose to format it as ext2, ext3, or reiserfs. More information about file systems is in 1.1.6, “File systems in Linux” on page 5. In Example 3-10 on page 154, we create an ext2 file system via the shell command line.

*Example 3-10 Formatting a Linux partition*

---

```
mkfs.ext2 /dev/sdb1
mke2fs 1.23, 15-Aug-2001 for EXT2 FS 0.5b, 95/08/09
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
384768 inodes, 769104 blocks
38455 blocks (5.00%) reserved for the super user
First data block=0
24 block groups
32768 blocks per group, 32768 fragments per group
16032 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912

Writing inode tables: done
Writing superblocks and filesystem accounting information: done
```

---

In Example 3-11, we format a swap partition.

*Example 3-11 Formatting a swap partition*

---

```
#mkswap /dev/sdb2
Setting up swspace version 1, size = 1036378112 bytes
```

---

**Note:** Do not create a swap partition more than twice the size of your RAM memory.

Next, create a directory where the formatted partition will be mounted, for example type `mkdir /data`, then modify the file `/etc/fstab` by adding the lines shown in Example 3-12 so the partition will be mounted at boot time.

*Example 3-12 Adding the partition in file /etc/fstab*

---

/dev/sdb1	/data	ext2	defaults	1 1
/dev/sdb2	swap	swap	defaults	0 0

---

When you reboot the server, your new file system will be mounted.

### 3.2.3 Scripts

In this section we describe how to create a shell script. Shell scripts are a powerful method by which to customize your Linux server. As an example, we will create a simple script. This script will erase the log files that are more than 2 months old. Example 3-13 gives the actual code.

**Note:** Each shell has its own syntax for scripts. The scripts we created are made for the **BASH** shell.

### Example 3-13 Log eraser

---

```
#!/bin/bash

## Log eraser ##

LPATH=/var/log
NR_OF_DAYS=60

for i in `find $LPATH -atime +$NR_OF_DAYS`
do
rm -f $i
done
```

---

- ▶ The first line **#!/bin/bash** tells the environment that the script will run. This line is to be treated as is and should not be modified.
- ▶ The sixth line sets the variable **LPATH** to equal **/var/log** and the seventh line sets the variable **NR\_OF\_DAYS** to 60. We recommend that you use variables because it makes it easier to debug your script.
- ▶ **\$LPATH** and **\$NR\_OF\_DAYS** indicate that you wish to use the value of the specified variable.
- ▶ **find \$LPATH -atime +\$NR\_OF\_DAYS** will search in the **/var/log** directory for files older than 60 days.

**Note:** For more information about **find** consult the man page: *man find*.

- ▶ Next is a **for** loop. For every value of **i**, we will run the command **rm -f \$i** which will remove every file specified by the value of **i**.
- ▶ Lines that start with a **#** are comments but there are special cases, such as the first line or the comments utilized by the **chkconfig** command.

Save the file as **log\_erase.sh**. We recommend that you create a directory, such as **/scripts**, in order to keep your scripts in a single location. To be able to execute the script, you have to modify the rights of the file. Run the command **chmod 700 /scripts/log\_eraser.sh**. You will be the only one who can read, write, and execute the file. In case you were wondering, the 7 in the **chmod** command comes from adding the numerical values of the read(4), write(2), and execute(1) permissions together:  $4+2+1 = 7$ . The two zeros in the **chmod** command indicate that the group and the world (all other users) have no rights to the file. This

parallels the division of file permissions described in “File permissions” on page 135.

To run the script, you would type `/scripts/log_eraser.sh` if you placed the file in the `/scripts` directory.

**Attention:** This script is intended primarily as an example that can be adapted to other situations. Although it works, you might want to consider a more sophisticated algorithm for the management of your log files, or use the built-in `logrotate` daemon.

### 3.2.4 Crontab

In everyday life, you may have several scripts for maintaining your server. **Crontab** is a scheduler in Linux that automates the process of running these scripts. To list the scheduled programs in crontab, log in as root and type **crontab -l**. On a fresh Linux installation, you will not see anything or else will receive a message “no crontab for root.”

#### *Example 3-14 Crontab example*

---

```
20 * * * * /scripts/script1
20 0 03 08 * /scripts/script2
0 0,6,12,18 * * * /scripts/script3
30 2 * * 6 /scripts/script4
0 0 * * 6 /scripts/log_eraser.sh
*/10 * * * * /scripts/script5
```

---

Following is an explanation of the crontab syntax. The six fields are:

Minutes | Hour | Day of the month | Month | Day of the week | Path

The lines in the crontab example have the following meanings:

- ▶ At 20 minutes past each hour run `/scripts/script1`.
- ▶ At 20 minutes, at midnight, on 03 august, run `/scripts/script2`.
- ▶ On 12 Am, 6 Am, 12 PM and 6 PM, on every day, run `/scripts/script3`.
- ▶ At 30 minutes, at 2 AM, on every Saturday, run `/scripts/script4`.
- ▶ At midnight, on every Saturday run `/scripts/log_eraser.sh`.
- ▶ Every 10 minutes run `/scripts/script5`.

**Tips:**

- ▶ Be sure the date is set correctly on the server.
- ▶ A week starts on Sunday. Thus, to run a job on a Sunday, enter 0, not 7.

To create a schedule:

- ▶ Log in as root and at the command prompt type **crontab -e**.
- ▶ Press **i** to insert data.
- ▶ Enter a value for all six entries. Use **\*** when an entry is not applicable.
- ▶ After you finish, press the Escape key and **:wq** (which means write and quit).

**Notes:**

- ▶ The crontab uses vi as the default text editor. The commands described here assume the use of vi.
- ▶ There is a graphical front end to cron called KCron.

### 3.2.5 Network status

Sometimes it is very useful to know who is connected to your server and what is happening. In this section, we describe the functions of the **netstat** command and the **iptraf** utility.

**Important:** The information in this section requires some TCP/IP protocol knowledge. Explaining all details in the screen captures is beyond the scope of this book, but enough information is provided to explain the common use of these network status tools. To learn more about TCP/IP, see the IBM Redbook *TCP/IP Tutorial and Technical Overview*, GG24-3376.

#### Netstat command

Log in as root and type **netstat** and you will see a screen similar to the one shown in Figure 3-9 on page 159.

From left to right, the columns have the following meanings.

▶ **Proto**

The protocol used by sockets (TCP, UDP, raw)

▶ **Recv-Q**

The count of bytes not copied by the user program connected to this socket

► **Send-Q**

The count of bytes not acknowledged by the remote host

► **Local Address**

Address and port number of the local end of the socket

► **Foreign Address**

Address and port number of the remote end of the socket

► **State**

The state of the socket. Since there are no states in raw mode and usually no states used in UDP, this column may be blank, but it can be one of several values:

– ESTABLISHED

The socket has an established connection.

– SYN\_SENT

The socket is actively attempting to establish a connection.

– SYN\_RECV

A connection request has been received from the network.

– FIN\_WAIT1

The socket is closed and the connection is shutting down.

– FIN\_WAIT2

Connection is closed and the socket is waiting for a shutdown from the remote end.

– TIME\_WAIT

The socket is waiting after close to handle packets still in the network.

– CLOSED

The socket is not being used.

– CLOSE\_WAIT

The remote end has shut down and is waiting for the socket to close.

– LAST\_ACK

The remote end has shut down and the socket is closed but still waiting for acknowledgement.

– LISTEN

The socket is listening for incoming connections. Such sockets are not included in the output unless you specify the --listening (-l) or --all (-a) option.



- CLOSING  
Both sockets are shut down but we still don't have all our data sent.
- UNKNOWN  
The state of the socket is unknown.

```

root@andrew:~
[root@andrew root]# netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 192.168.1.111:1396      192.168.1.111:1396     ESTABLISHED
tcp        0      0 andrew:32771           andrew:8989            ESTABLISHED
tcp        0      0 andrew:8989            andrew:32771          ESTABLISHED
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type       State      I-Node Path
unix    7      [ ]        DGRAM      -          1021    /dev/log
unix    3      [ ]        STREAM     CONNECTED  8107    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  8106    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  8104    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  8103    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  8101    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  8100    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  6246    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  6245    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  6243    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6242    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6235    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6234    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  6222    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6221    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6218    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6217    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  6214    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  6213    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  6209    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6208    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6203    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  6202    /tmp/.ICE-unix/1272
unix    3      [ ]        STREAM     CONNECTED  4974    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  4973    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  4969    /tmp/.X11-unix/X0
unix    3      [ ]        STREAM     CONNECTED  4968    /tmp/.ICE-unix/1247
unix    3      [ ]        STREAM     CONNECTED  4965    /tmp/.ICE-unix/1247

```

Figure 3-9 netstat output

### Netstat options

The netstat command can be run with options. Some of the options and their meanings are as follows:

- a Show both listening and non-listening sockets; illustrated in Figure 3-10 on page 160.
- p Show the PID and name of the program to which each socket belongs; illustrated in Figure 3-11 on page 160.
- s Display summary statistics for each protocol; illustrated in Figure 3-12 on page 161.

```

root@andrew:~
[root@andrew root]# netstat -a
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 *:18208                 *:                       LISTEN
tcp        0      0 *:18191                 *:                       LISTEN
tcp        0      0 *:x11                   *:                       LISTEN
tcp        0      0 *:10000                 *:                       LISTEN
tcp        0      0 *:18192                 *:                       LISTEN
tcp        0      0 *:ftp                   *:                       LISTEN
tcp        0      0 *:ssh                   *:                       LISTEN
tcp        0      0 andrew:8989             *:                       LISTEN
tcp        0      20 192.168.1.2:ssh         192.168.1.111:1396     ESTABLISHED
tcp        0      0 andrew:32771            andrew:8989            ESTABLISHED
tcp        0      0 andrew:8989             andrew:32771           ESTABLISHED
udp        0      0 *:10000                 *:                       LISTEN
udp        0      0 *:990                   *:                       LISTEN
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State      I-Node Path
unix    2      [ ACC ] STREAM    LISTENING   1205  /tmp/.font-unix/fs7100
unix    2      [ ACC ] STREAM    LISTENING   4795  /tmp/ksocket-root/kdeinit-:0
unix    2      [ ACC ] STREAM    LISTENING   4828  /tmp/ksocket-root/klauncherPfMg8b.sla
unix    7      [ ] DGRAM      1021  /dev/log
unix    2      [ ACC ] STREAM    LISTENING   4725  /tmp/.X11-unix/X0
unix    2      [ ACC ] STREAM    LISTENING   1149  /dev/gpmctl
unix    2      [ ACC ] STREAM    LISTENING   4892  /tmp/mcop-root/andrew-04ed-3d267468
unix    2      [ ACC ] STREAM    LISTENING   4802  /tmp/.ICE-unix/1247

```

Figure 3-10 netstat -a output

```

root@andrew:~
[root@andrew root]# netstat -p
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      20 192.168.1.2:ssh         192.168.1.111:1396     ESTABLISHED 1701/sshd
tcp        0      0 andrew:32771            andrew:8989            ESTABLISHED 910/cprid
tcp        0      0 andrew:8989             andrew:32771           ESTABLISHED 953/cpd
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type       State      I-Node PID/Program name  Path
unix    7      [ ] DGRAM      1021  714/syslogd      /dev/log
unix    3      [ ] STREAM    CONNECTED   8107  1247/kdeinit: dcops /tmp/.ICE-unix/1247
unix    3      [ ] STREAM    CONNECTED   8106  1465/kdeinit: konso /tmp/.ICE-unix/1247
unix    3      [ ] STREAM    CONNECTED   8104  1272/ksmserver   /tmp/.ICE-unix/1247

```

Figure 3-11 netstat -p output

```
root@andrew:~  
[root@andrew root]# netstat -s  
Ip:  
  2776 total packets received  
  0 forwarded  
  0 incoming packets discarded  
 2753 incoming packets delivered  
 1397 requests sent out  
Icmp:  
  15 ICMP messages received  
  0 input ICMP message failed.  
  ICMP input histogram:  
    destination unreachable: 11  
    echo replies: 4  
  11 ICMP messages sent  
  0 ICMP messages failed  
  ICMP output histogram:  
    destination unreachable: 11  
Tcp:  
  24 active connections openings  
  0 passive connection openings  
  0 failed connection attempts  
  0 connection resets received  
  3 connections established  
 1172 segments received  
 1322 segments send out  
  0 segments retransmited  
  0 bad segments received.  
 11 resets sent  
Udp:  
  25 packets received  
 11 packets to unknown port received.  
  0 packet receive errors  
  60 packets sent  
TcpExt:  
  ArpFilter: 0  
  17 TCP sockets finished time wait in fast timer  
 18 delayed acks sent  
  1 delayed acks further delayed because of locked socket  
  3 packets directly queued to recvmsg prequeue.  
  3 packets directly received from prequeue  
 264 packets header predicted  
  TCPPureAcks: 439  
  TCPHPAcks: 75  
  TCPRenoRecovery: 0  
  TCPSackRecovery: 0  
  TCPSACKReneging: 0  
  TCPFACKReorder: 0  
  TCPSACKReorder: 0  
  TCPRenoReorder: 0  
  TCPTSReorder: 0  
  TCPFullUndo: 0  
  TCPPartialUndo: 0  
  TCPSACKUndo: 0
```

Figure 3-12 netstat statistic output

## IPTraf utility

IPTraf is an IP network statistics utility. It is included in both the RedHat and SuSE distributions. In this section, we present technical information about IPTraf.

**Note:** You must be logged in as root to run the IPTraf utility.

IPTraf is a console-based network statistics utility for Linux. It gathers a variety of figures, such as TCP connection packet and byte counts, interface statistics and

activity indicators, TCP/UDP traffic breakdowns, and LAN station packet and byte count.

### ***Features***

Among the features provided by IPTraf are the following:

- ▶ An IP traffic monitor that shows information on the IP traffic passing over your network. Includes TCP flag information, packet and byte counts, ICMP details, OSPF packet types.
- ▶ General and detailed interface statistics showing IP, TCP, UDP, ICMP, non-IP and other IP packet counts, IP checksum errors, interface activity, packet size counts.
- ▶ A TCP and UDP service monitor showing counts of incoming and outgoing packets for common TCP and UDP application ports.
- ▶ A LAN statistics module that discovers active hosts and displays statistics showing the data activity on them.
- ▶ TCP, UDP, and other protocol display filters, allowing you to view only traffic you're interested in.
- ▶ Logging.
- ▶ Support for Ethernet, FDDI, ISDN, SLIP, PPP, and loopback interface types.
- ▶ Utilizes the built-in raw socket interface of the Linux kernel, allowing it to be used over a wide range of supported network cards.
- ▶ Full-screen, menu-driven operation.

### ***Protocols recognized***

- ▶ IP
- ▶ TCP
- ▶ UDP
- ▶ ICMP
- ▶ IGMP
- ▶ IGP
- ▶ IGRP
- ▶ OSPF
- ▶ ARP
- ▶ RARP

Non-IP packets will simply be indicated as “Non-IP” and, on Ethernet LANs, will be supplied with the appropriate Ethernet addresses.

### ***Supported Interfaces***

- ▶ Local loopback
- ▶ All Linux-supported Ethernet interfaces

- ▶ All Linux-supported FDDI interfaces
- ▶ SLIP
- ▶ Asynchronous PPP
- ▶ Synchronous PPP over ISDN
- ▶ ISDN with Raw IP encapsulation
- ▶ ISDN with Cisco HDLC encapsulation
- ▶ Parallel Line IP

The information generated by IPTraf can be valuable in making network organization decisions, troubleshooting LANs, and tracking activity of various IP hosts.

Once installed on the system, the IPTraf utility will look like Figure 3-13.

```

root@anet: /root
IPTraf
Source ----- Destination ----- Packets --- Bytes Flags Iface
62.231.66.55:ssh 192.168.1.111:1416 > 524 131508 -PA- eth0
192.168.1.111:1416 62.231.66.55:ssh > 262 10480 --A- eth0
24.65.31.164:6699 192.168.1.3:1192 > 501 704072 -PA- eth2
192.168.1.3:1192 24.65.31.164:6699 > 0 0 ---- eth2
24.65.31.164:6699 192.168.1.3:1192 > 501 704072 -PA- eth0
192.168.1.3:1192 24.65.31.164:6699 > 255 10248 --A- eth0
62.231.66.55:1156 61.193.98.91:6699 > 2 128 -PA- eth2
61.193.98.91:6699 62.231.66.55:1156 > 0 0 ---- eth2
192.168.1.3:1156 61.193.98.91:6699 > 2 128 -PA- eth0
61.193.98.91:6699 192.168.1.3:1156 > 2 80 --A- eth0
192.168.1.3:1498 62.137.111.23:6699 > 45 25920 --A- eth0
62.137.111.23:6699 192.168.1.3:1498 > 28 1120 --A- eth0
62.231.66.55:1498 62.137.111.23:6699 > 45 25920 --A- eth2
62.137.111.23:6699 62.231.66.55:1498 > 0 0 ---- eth2
192.168.1.5:1914 216.55.95.34:http > 18 1191 CLOSED eth0
216.55.95.34:http 192.168.1.5:1914 > 26 35175 CLOSED eth0
62.231.66.55:1315 64.12.27.145:5190 > 1 46 -PA- eth2
64.12.27.145:5190 62.231.66.55:1315 > 0 0 ---- eth2
216.55.95.34:http 192.168.1.5:1914 > 25 35135 --A- eth2
192.168.1.5:1914 216.55.95.34:http > 0 0 ---- eth2
192.168.1.5:1915 216.55.95.34:http > 5 626 CLOSED eth0
216.55.95.34:http 192.168.1.5:1915 > 4 306 CLOSED eth0
62.231.66.55:1915 216.55.95.34:http > 5 626 --A- eth2
TCP: 16 entries ----- Active -----
ARP (42 bytes) from 0000c09929c7 to 0050bf345d11 on eth0
ARP (60 bytes) from 0050bf345d11 to 0000c09929c7 on eth0
ARP (42 bytes) from 0000c09929c7 to 00a00c1269ea on eth0
ARP (60 bytes) from 00a00c1269ea to 0000c09929c7 on eth0

Top ----- Elapsed time: 0:00 -----
IP: 2055212 TCP: 2055212 UDP: 0 ICMP: 0 Non-IP: 204
Up/Dn/PqUp/PqDn-scr1 actv win W-chg actv win M-more TCP info X/Ctrl+X-Exit

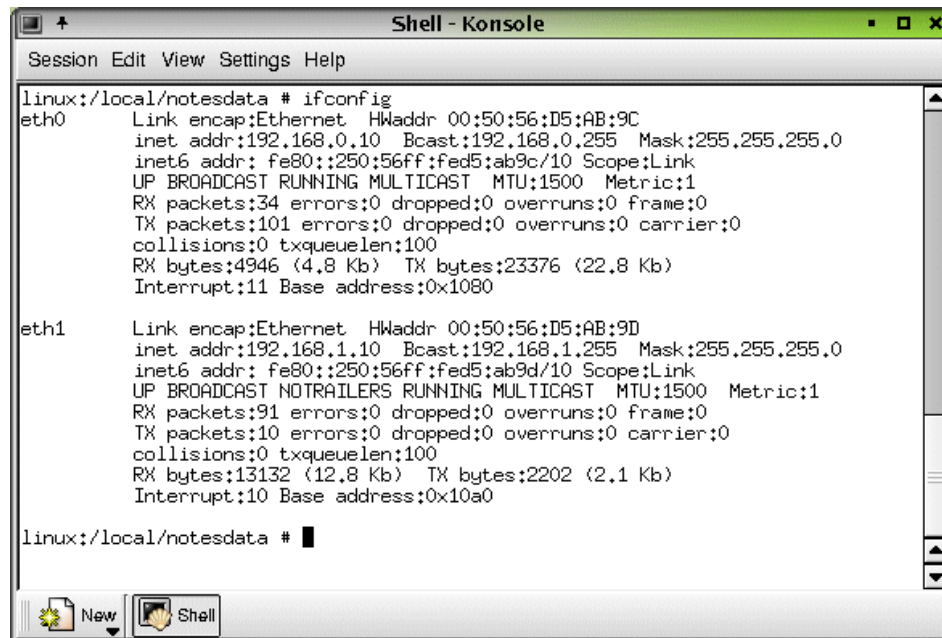
```

Figure 3-13 IPTraf utility

### 3.2.6 Multiple network cards (Private LAN)

This section covers how to configure Domino to use multiple network cards and how to create a private LAN. The reason for creating a private LAN could be for cluster traffic, inter-server, or for administration. Each partition server requires a separate network card.

Use the **ifconfig** command to check the configuration of the network cards (see Figure 3-14).



```
linux:/local/notesdata # ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:56:D5:AB:9C
          inet addr:192.168.0.10  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::250:56ff:fed5:ab9c/10 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:34 errors:0 dropped:0 overruns:0 frame:0
          TX packets:101 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          RX bytes:4946 (4.8 Kb)  TX bytes:23376 (22.8 Kb)
          Interrupt:11 Base address:0x1080

eth1      Link encap:Ethernet  HWaddr 00:50:56:D5:AB:9D
          inet addr:192.168.1.10  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::250:56ff:fed5:ab9d/10 Scope:Link
          UP BROADCAST NOTRAILERS RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:91 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          RX bytes:13132 (12.8 Kb)  TX bytes:2202 (2.1 Kb)
          Interrupt:10 Base address:0x10a0

linux:/local/notesdata #
```

Figure 3-14 *ifconfig* command

Make sure that the IP addresses for network cards are configured correctly for name resolution. Use one of the following for name resolution: DNS or host files. See Figure 3-15 on page 165 for an example of a Linux host file.

```
linux:/local/notesdata # tail /etc/hosts
fe00::0      ipv6-localnet
ff00::0      ipv6-mcastprefix
ff02::1      ipv6-allnodes
ff02::2      ipv6-allrouters
ff02::3      ipv6-allhosts
192.168.0.10  linux.local  notes0
192.168.1.10  linux.local  notes1
linux:/local/notesdata #
```

Figure 3-15 /etc/hosts

The host file contains IP addresses, hostname (a host can only have one hostname) and aliases (a host can have many aliases). In Figure 3-15 the host linux.local has two IP address and two aliases.

Edit the server's notes.ini file, as shown in Figure 3-16 on page 166.

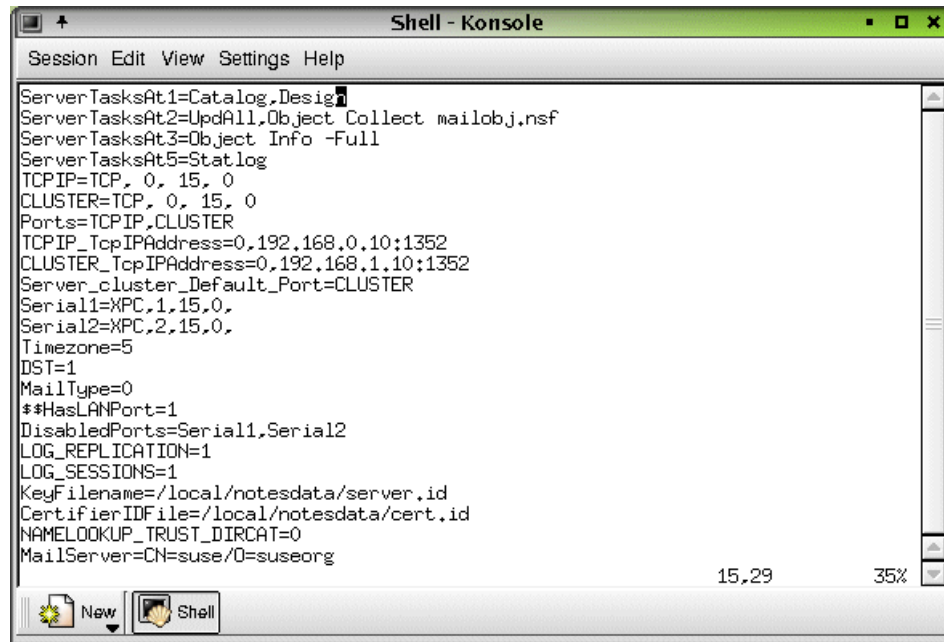


Figure 3-16 notes.ini setting for multiple network cards

The lines TCPIP=TCP, 0, 15, 0 and CLUSTER=TCP, 0, 15, 0 define the port names TCPIP and Cluster to be TCP ports.

The PORTS= line defines which ports are enabled at startup.

The TCPIP\_TcpAddress= and CLUSTER\_TcpAddress= lines define which IP address and IP port are bound to which Domino ports.

Server\_Cluster\_Default\_Port tells the Domino cluster task which port to use for cluster data.

Edit the HTTP tab on the Internet Protocols section of the server document to include the hostname and bind to host name (see Figure 3-17).

**Note:** If you have installed a partition server you must use the hostname and bind to host option.



Figure 3-17 shows a screenshot of the 'Internet Protocols' tab in a configuration window. The 'HTTP' sub-tab is selected. Under the 'Basics' section, the 'Host name(s):' field is set to 'notes0' and the 'Bind to host name:' dropdown is set to 'Enabled'.

Figure 3-17 Bind to host

Configure the Notes Network port on the Ports tab of the server document (see Figure 3-18).

Figure 3-18 shows a screenshot of the 'Ports' tab in a configuration window. The 'Notes Network Ports' sub-tab is selected. Below the sub-tabs, there is a table with the following data:

Port	Protocol	Notes Network	Net Address	Enabled
<input type="checkbox"/> TCPIP	TCP	<input type="checkbox"/> TCPIP Network	<input type="checkbox"/> Notes0	<input type="checkbox"/> ENABLED
<input type="checkbox"/> CLUSTER	TCP	<input type="checkbox"/> CLUSTER Network	<input type="checkbox"/> Notes1	<input type="checkbox"/> ENABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> DISABLED

Figure 3-18 Notes Network Ports

### 3.2.7 System logs

The Linux log system is both flexible and powerful, and in many situations, the log information will be very useful.

Logs can be generated by the system or by applications. Linux keeps logs in /var/log unless the administrator changes the path. The program (daemon) responsible for generating the logs is **syslogd**; log entries are caused by events.

Almost every application can send information (events) to the syslogd. The syslogd daemon can be set to start at system boot or not, but we recommend you set syslogd to start when the system boots (this is the default), as shown in Figure 3-19 on page 168.

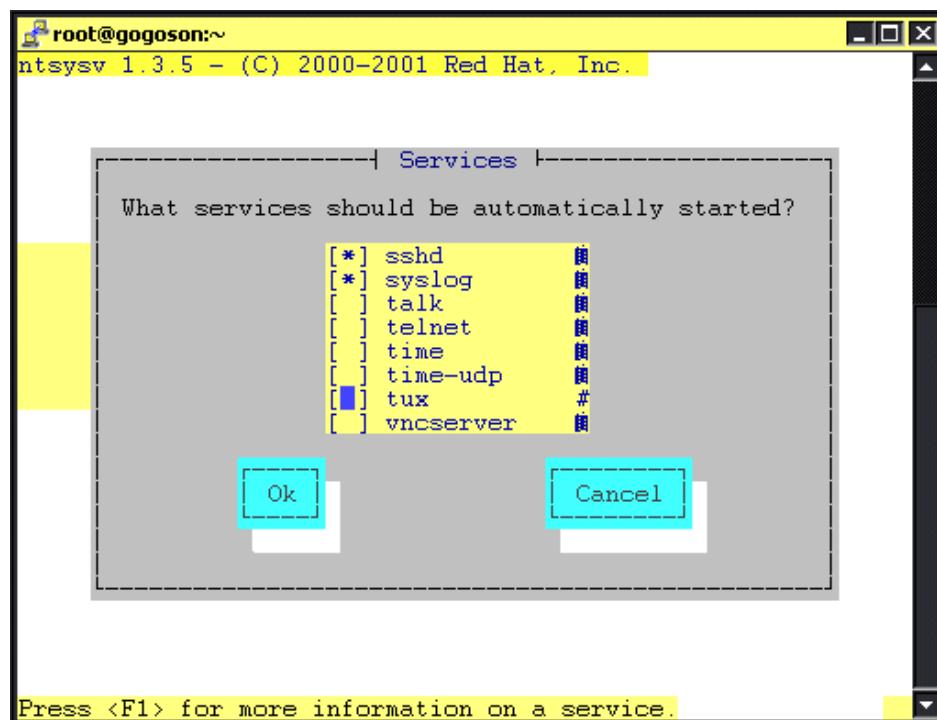
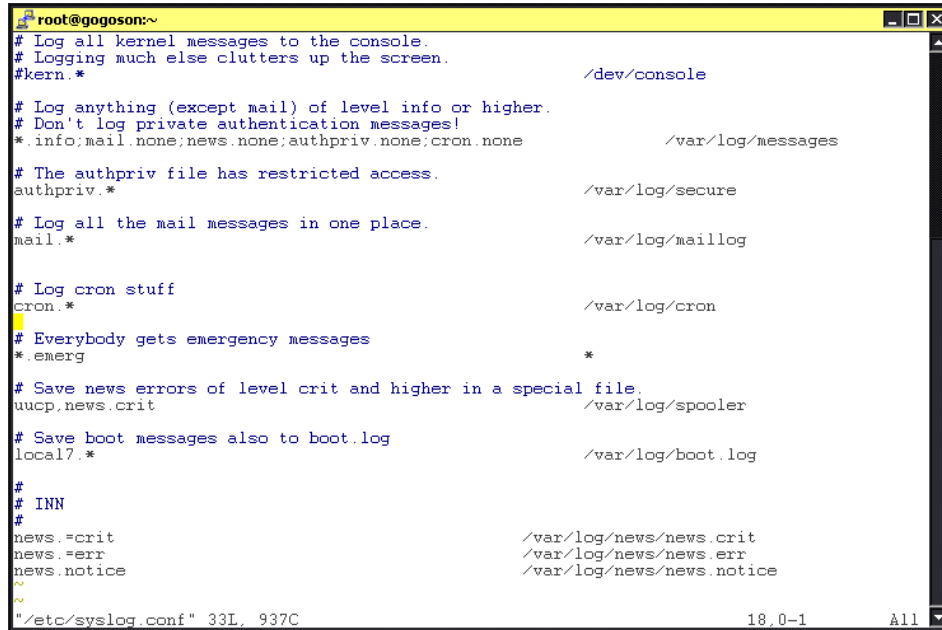


Figure 3-19 Red Hat system services

Figure 3-20 shows the syslogd configuration file /etc/syslog.conf.



```
root@gogoso:~
# Log all kernel messages to the console.
# Logging much else clutters up the screen.
#kern.*                                /dev/console

# Log anything (except mail) of level info or higher.
# Don't log private authentication messages!
* info;mail.none;news.none;authpriv.none;cron.none    /var/log/messages

# The authpriv file has restricted access.
authpriv.*                                             /var/log/secure

# Log all the mail messages in one place.
mail.*                                                 /var/log/maillog

# Log cron stuff
cron.*                                                 /var/log/cron

# Everybody gets emergency messages
*.emerg                                                *

# Save news errors of level crit and higher in a special file.
uucp,news.crit                                         /var/log/spooler

# Save boot messages also to boot.log
local7.*                                               /var/log/boot.log

#
# INN
#
news.=crit                                             /var/log/news/news.crit
news.=err                                             /var/log/news/news.err
news.notice                                           /var/log/news/news.notice
~
~
"/etc/syslog.conf" 33L, 937C                               18,0-1    All
```

Figure 3-20 Syslog configuration file

By default, all system messages go in the `/var/log/messages` file unless otherwise specified. In the syslog configuration file, there are specifications for other log files for mail, news, and so forth.

The log files can be redirected to other paths by editing the `syslog.conf` or by moving the file and creating a link to the new location.

There are situations when the system administrator wants to see the log information in real time. To do so, log in as root and type at the shell command prompt **tail -f /var/log/messages**. The **tail** command will watch the log file and any information that is written to the log file is displayed in the console window as show in Figure 3-21 on page 170.

**Note:** For more information about the **tail** command, type **man tail**.

```

[root@gogoso root]# tail -f /var/log/maillog
Jul  8 09:36:05 gogoso sendmail[1806]: g686a5M01806: from=root, size=227, class=0, nrcpts=1, msgid=<200207080636.g686a5M01806@localhost.localdomain>, relay=root@localhost
Jul  8 09:36:06 gogoso sendmail[1806]: g686a5M01806: to=root, ctladdr=root (0/0), delay=0:00:01, xdelay=00:00:01, mailer=local, pri=30227, dsn=2.0.0, stat=Sent

[root@gogoso root]# tail -f /var/log/messages
Jul  8 09:31:44 gogoso syslogd 1.4.1: restart.
Jul  8 12:31:23 gogoso sshd(pam_unix)[1977]: session opened for user root by (uid=0)
Jul  8 13:50:56 gogoso ftpd[2109]: wu-ftp - TLS settings: control allow, client_cert allow, data allow
Jul  8 13:50:58 gogoso ftp(pam_unix)[2109]: session opened for user root by (uid=0)
Jul  8 13:50:58 gogoso ftpd: 192.168.1.111: root[2109]: FTP LOGIN FROM 192.168.1.111 [192.168.1.111], root
Jul  8 13:51:36 gogoso ftp(pam_unix)[2109]: session closed for user root
Jul  8 13:51:36 gogoso ftpd: 192.168.1.111: root: QUIT[2109]: FTP session closed

```

Figure 3-21 tail -f /var/log/messages

## 3.2.8 Remote administration

Linux servers can be administered remotely and there are many software programs available for this. Several of the most commonly used are described here.

### Webmin

Webmin is a powerful tool for remotely administering a Linux server. It can be downloaded for free from:

<http://www.webmin.com>

It can be downloaded either as a .rpm package or as a source file. Download the .rpm file, log in as root, and use the Package Manager to install the Webmin software. You can also use rpm from the shell command line.

Once installed, connect from a Web browser to the server:

`http://<server IP address>:10000`

You will be prompted for your username (root) and a password (root's password). After login, the Web browser should look like the example shown in Figure 3-23 on page 172.

Through the Webmin software, the system administrator can configure the server and its applications from virtually anywhere. The Webmin server configuration page is easy to use but has numerous capabilities, as shown in Figure 3-23.

**Attention:** We recommend that you use the Webmin software only from an internal network if you do not use SSL authentication.

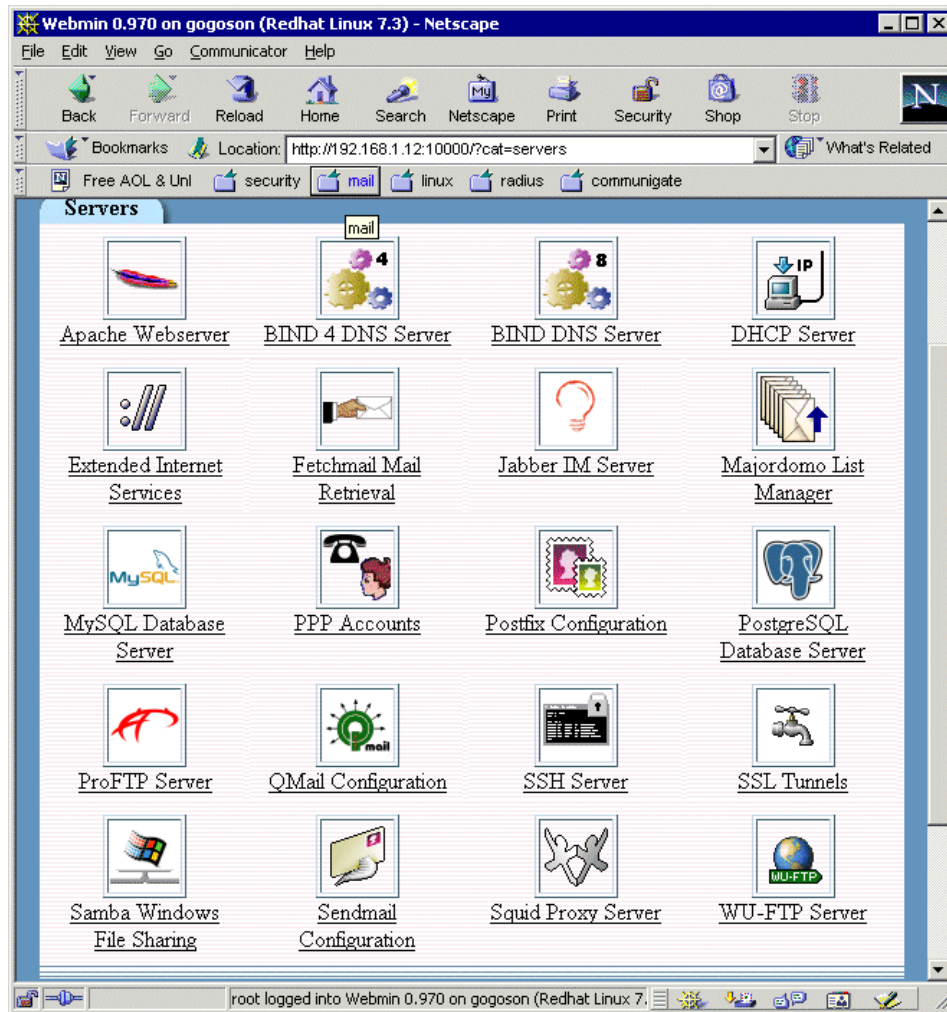


Figure 3-22 Webmin server configuration page



Figure 3-23 Webmin interface

## VNC

VNC is another program for remote administration of Linux servers. You can download the VNC tool as well as obtain more information about it at:

<http://www.uk.research.att.com/vnc/index.html>

To install VNC on the Linux machine, download the Linux version, unpack the files (tar xvfz vnc-XX.YY.tar.gz, where XX and YY are version and release numbers) and copy the files to /usr/bin.

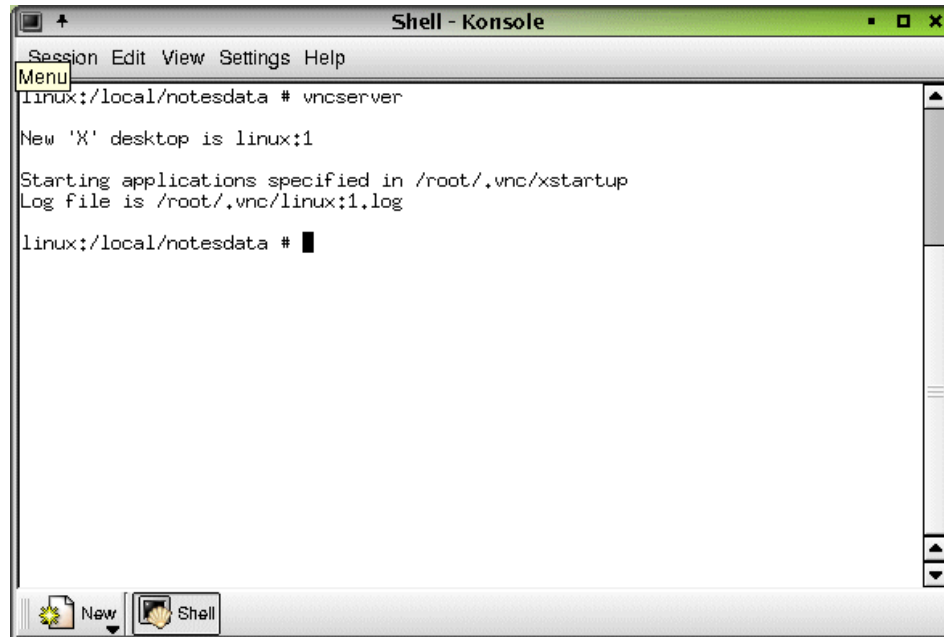


Figure 3-24 Starting VNC Server on Linux

To start the server, run **vncserver** from a shell. This will prompt for a password to be used when connecting from another machine. The machine name and the windows number will be displayed (see Figure 3-24).

To connect to the VNC server, run the VNC viewer on you client and enter the hostname:window (see Figure 3-25) and then click **OK**. Enter the password when prompted.

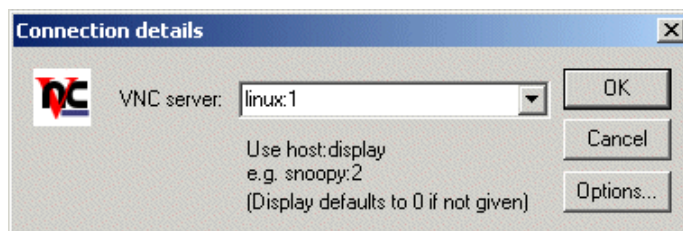


Figure 3-25 VNC viewer

## 3.3 Domino security

In general, the principles of Domino security are the same from platform to platform. This section provides an overview of initial options available for securing a Domino server.

### 3.3.1 Domino 6 server document

Once you have the server set up, open the Domino Directory (names.nsf) and review the server document. This document controls myriad server functions, including security.

The Security tab contains settings for the following:

- ▶ Access server - The default is blank. At the very least, enter the organization name used during setup, which in our case was \*/ITSO. This helps to ensure that only those to whom you have issued an ID can access the server.

**Tip:** You can add other domains to the Access Server field after you have added the appropriate cross-certification. Remember that a Domino server will not be able to authenticate users or servers from a different organization unless it has a cross-certificate.

- ▶ Check passwords on Notes IDs - The advantage of enabling this feature is that when users listed in the Domino Directory lose their Notes ID, they will be able to change the password on the backup Notes ID and prevent the lost ID from accessing the Domino server. The disadvantage is that, like many security options, it slightly increases the overall administrative burden.
- ▶ Create new databases - Enter individual names, or preferably, create an administration group and enter the name of the group. If you leave this field blank, anyone who can access the server can create new databases.
- ▶ Create replica databases - Enter individual names, or preferably, create an administration group and enter the name of the group. If you leave this field blank, no one can create new replicas.

**Important:** If the Create new database field is empty, it means that anyone can create new databases; but if the Create new replica field is blank, it means that no one can create a new replica.

The Ports - Internet Ports tab contains settings for the following:

- ▶ On the Web tab, you can redirect HTTP to SSL once you have the SSL certificates in place. The same is true for the Directory tab and LDAP, as well



as the other listed services. All of these services can be redirected to SSL once you have the SSL certificates in place.

The Internet Protocols tab contains numerous options for Web access; consult the appropriate Lotus documentation for details.

**Tip:** If you are using the Lotus Notes 6 client via CrossOver Office or a Windows machine, you can click and hold the mouse to view pop-up help on many items in the server document.

### 3.3.2 Database ACLs

You should review the ACLs of at least the following databases: names.nsf, admin4.nsf, and certlog.nsf.

- ▶ Set the Default entry to No Access. By doing so, you will force both Notes and Web clients to authenticate. With Default set to No Access, you do *not* need to add an Anonymous entry.

**Attention:** For databases where Default is not set to No Access, you should make certain that there is an Anonymous entry set to No Access unless you specifically wish to allow anonymous access, such as with a Web home page or a Web registration database.

- ▶ Assign an appropriate User Type to each entry. Make certain to differentiate Person and Server, as well as single (Person or Server) and group entries (Person Group or Server Group). A wildcard entry should be treated as a group.
- ▶ Consider using “Enforce a consistent ACL” for the Domino Directory (names.nsf) and Administration Requests database (admin4.nsf). This will help ensure that only the appropriate administrators make changes to these databases. Enforce a consistent ACL across all replicas also applies to databases which users replicate to their local machines. Therefore users cannot access locally data that they could not access on the server.

You must be careful with this option because if you accidentally omit the rights to access the database, it cannot be bypassed by accessing the database locally.

See the Lotus Domino Administration 6 help database for more information about using this option and about its limitations.

- ▶ Further Domino system control over databases can be managed through the Security tab of the Server document. From there one can assign additional administrative privileges over databases. The added database access these

settings can have should be taken into account when configuring database security. Special attention should be given to the field “Full Access administrator” if Full Access Administration is being used because it can bypass all ACL settings, including Enforce consistent ACL.

- In order to delegate administrative access to a database based on pubnames.ntf, an administrator will want to look at implementing the Extended ACL (also known as the xACL). This allows you to further restrict access to a database down to the field level. See the Lotus Domino Administration 6 help database for more information about xACL.

You should also consider the ACL of log.nsf since quite a bit of information can be gathered from the logs. However, you should balance the need to secure the log.nsf database with the need for Domino administrators and developers to view it. One solution is to set the Default entry to No Access, add a group with Manager access for administrators, and either add your organizational unit, for example \*/ITSO, with Reader access or else add a second group for developers and others. Whether the additional overhead of maintaining a second group for developers and others is worth the hassle depends on the location of the server (Internet, Intranet, or internal) and the level of logging. Any server not located behind one or more firewalls blocking internet traffic should be held to much more stringent ACL settings than internal servers.

There are a number of notes.ini variables that help with security as well as administration. While setting these will generate useful information in the log.nsf database, remember that all logging comes with a performance price. Only use the level of logging required for the server.

- log\_replication - As with all notes.ini settings, you can add this directly to the notes.ini by adding the line:

```
log_replication=1
```

or else by issuing the following command from the Domino console:

```
set config log_replication=1
```

A value of 1 will provide a summary of the replication once it finishes. A log level of 2 is useful when you prefer to know the specific types of changes that were replicated (data, ACL, view design, and so forth).

- log\_console - This is set to either 0 or 1. A value of 1 will record commands entered at the console.
- log\_sessions - This is set to either 0 or 1. A value of 1 will record each user session and so will generate a lot of log entries.
- log\_agentmanager - This is set to either 0 or 1. A value of 1 will record the start of agents in the log, which is quite useful for troubleshooting.

- `log_mailrouting` - A value of 20 is normal, though 10 can be used to record minimal information. A value of 30 or 40 should only be used temporarily while troubleshooting a specific mail routing problem.

**Important:** The `notes.ini` file must have a blank line at the bottom.

**Note:** More details about Domino security are in *Lotus Notes and Domino R5.0 Security Infrastructure Revealed*, SG24-5341.

## 3.4 Domino 6 administration

In this section, we highlight the use of the Domino 6 Web Administrator Client. The Domino 6 Web Administrator closely parallels the Domino 6 Administrator available for the Windows 32 client. This new feature provides Domino administrators using a Web browser with much, if not all, of the functionality available with the Windows Administrator client.

We then discuss the new Domino 6 Java Console, which is a separate console-controller pair that allows an administrator to work with a server even when the Domino Server is not responding.

### 3.4.1 Domino 6 Web Administrator

The Domino 6 Web Administrator is managed by the HTTP task. The first time this task starts it will automatically create the `webadmin.nsf` database if it does not already exist. Default access to this database is permitted to all Server Administrators and Full Server Administrators as defined in the Domino 6 server document under the Security tab. In Pre-release 1, any administrators added to the server document are updated to the `webadmin.nsf` Access Control List by the HTTP task.

**Note:** Refer to the Domino 6 Administration Help for detailed instructions on administering the Domino server.

### Domino 6 Web Administrator requirements

The requirements for using the Domino 6 Web Administrator are listed below.

#### **Software requirements**

In order to access the features of the Domino 6 Web Administrator, you need to have the following:

- ▶ Web browser
  - MS Internet Explorer 5.5 or 6.0 on Windows 98/NT4/W2K/XP
  - Netscape 4.7x on Windows 98/NT4/W2K/XP or Linux (RedHat 7.2 or SuSE 7.2)
- ▶ Domino 6 Server

### ***Domino tasks***

The Domino 6 Server must be running the following tasks to support the Domino 6 Web Administrator:

- The Administration Process (AdminP) on the same server
- The Certificate Authority (CA) on the same server or another Domino 6 server in order to register users
- Web server (HTTP)

**Note:** The process of registering users also requires the migration of the Notes certifier to the Certificate Authority process. This migration and other aspects of Domino 6 user registration are covered in detail in “Domino user registration” on page 248.

### **People & Groups tab**

Figure 3-26 illustrates the administration functions available to the Domino 6 administrator from a browser, including the Tools drop-down for user registration and group creation.

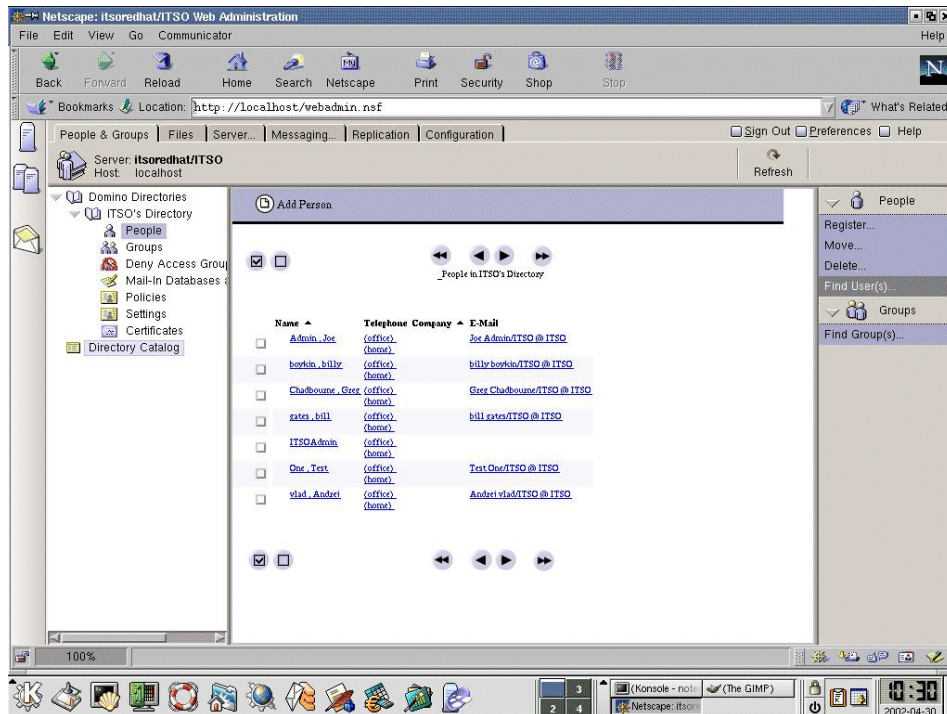


Figure 3-26 Domino 6 Web Administrator: People view

In the People view of the People & Groups tab, you are able to see the registered users of your Domino domain. You can register, move, and delete users using the links in the Tools pane located on the right side of the window.

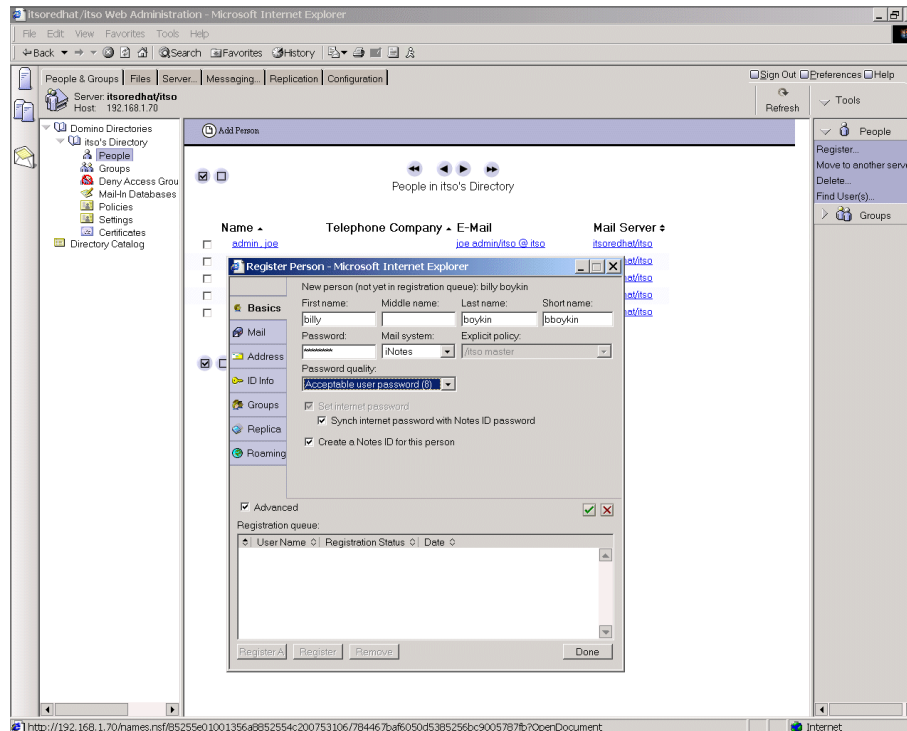


Figure 3-27 Domino 6 Web Administrator: Register users

Figure 3-27 shows an example of the user registration window. In this window, you enter the basic information about the user and then register the user in the Domino Directory. To learn more about registering users, refer to “Domino user registration” on page 248.

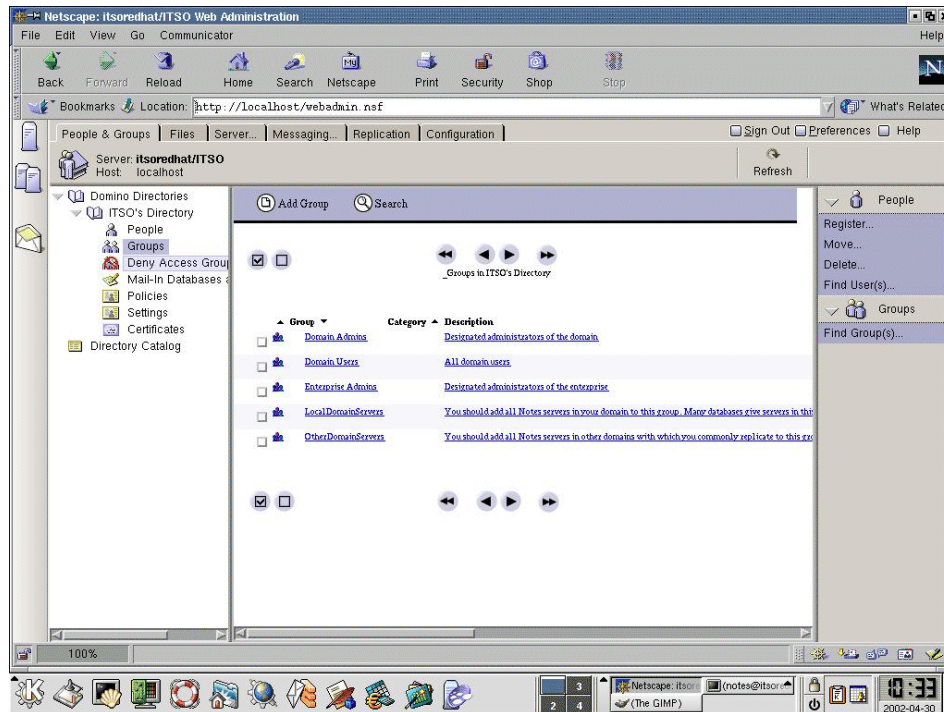


Figure 3-28 Domino 6 Web Administrator: Group view

In the Groups view of the People & Groups tab, you can see all the groups in your Domino Directory. Each group has a type; this type can be mail, access-control, deny list, server only, or else multi-purpose group. You can administer groups using the view buttons and the links in the Tools pane.

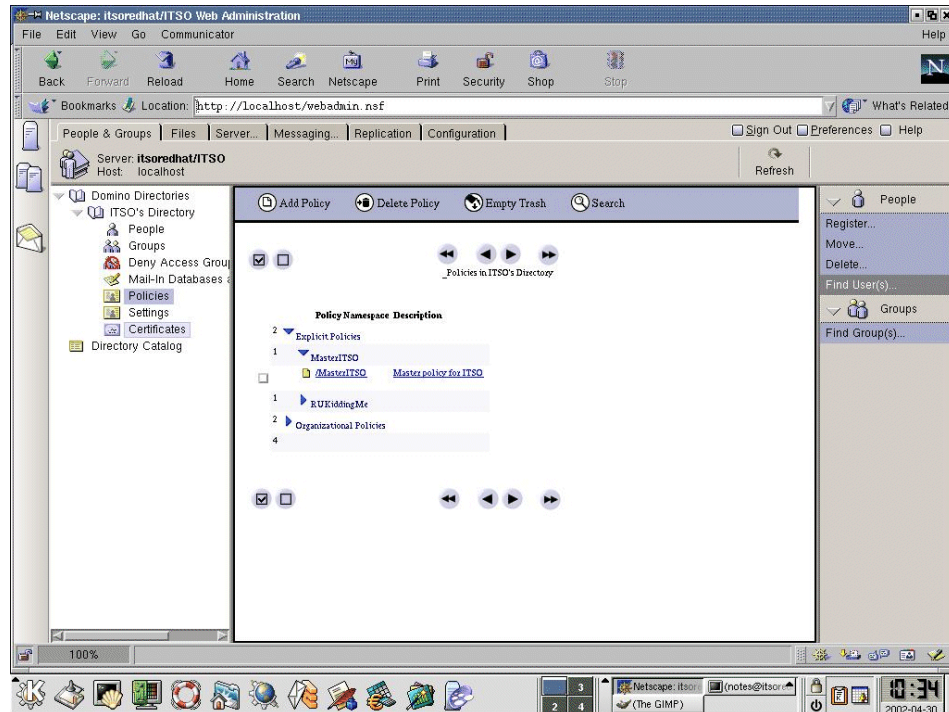


Figure 3-29 Domino 6 Web Administrator: Policies view

The Domino 6 Web Administrator allows a Domino administrator to work with Mail-In Databases, Policies (both explicit and organizational), Settings and Certificates.

Domino Administrators can create policies then, using an established hierarchy, automatically distribute those policies across a group, a department, or an entire organization. The use of policies makes it easy for administrators to establish and maintain standard settings and configurations; it also automates redundant administrative tasks.



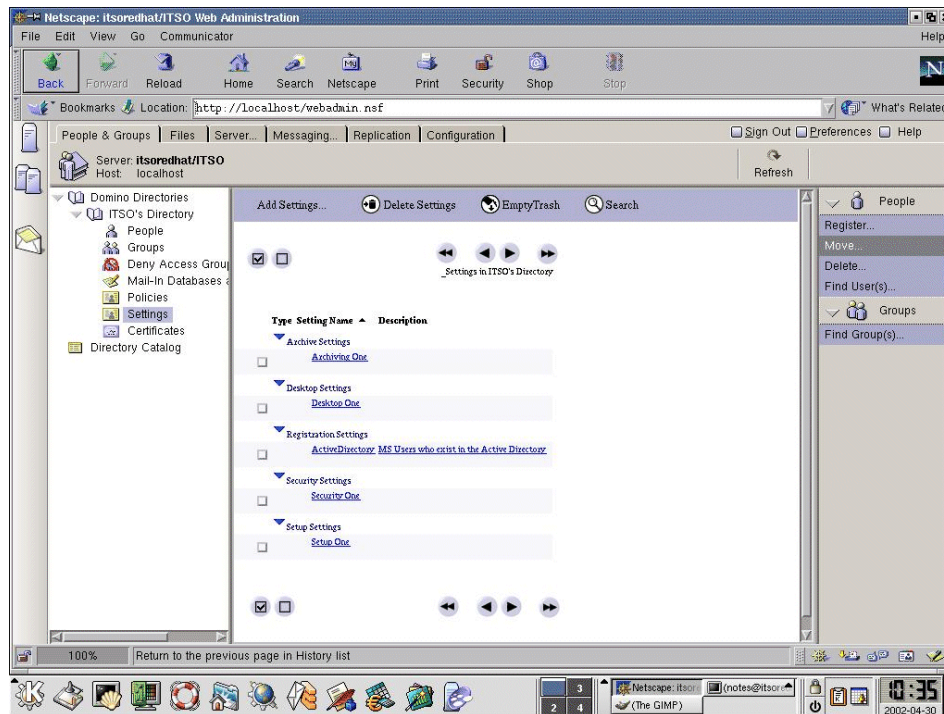


Figure 3-30 Domino 6 Web Administrator: Settings view

Policy setting documents organize settings by administrative function. The settings in these documents determine defaults, configuration, and rules that are applied to users or groups using Policy documents. Although policy setting documents define the default settings for users, there is no vehicle for assigning policy settings, except by using a Policy document. Policy setting documents are also where you control inheritance or enforcement of parent settings.

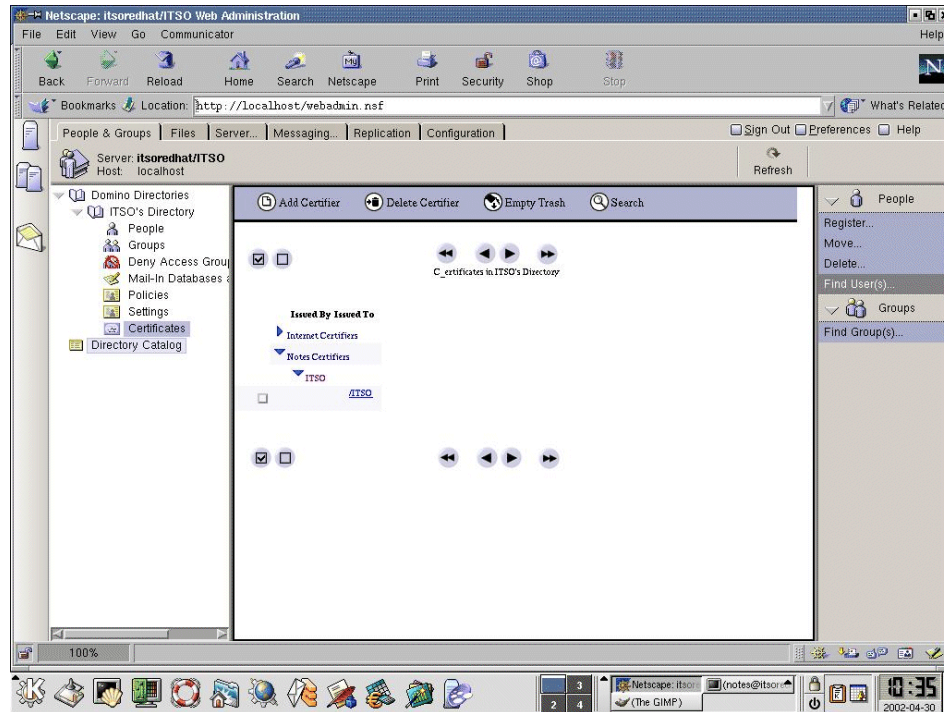


Figure 3-31 Domino 6 Web Administrator: Certificates view

The Certificates view allows you to view and administer the certificates used to authenticate users.

## Files tab

The Domino 6 Web Administrator provides the Domino administrator using a browser with file-level access to the operating system. The file-level view begins in the Domino data directory and includes all sub-directories of the data directory.

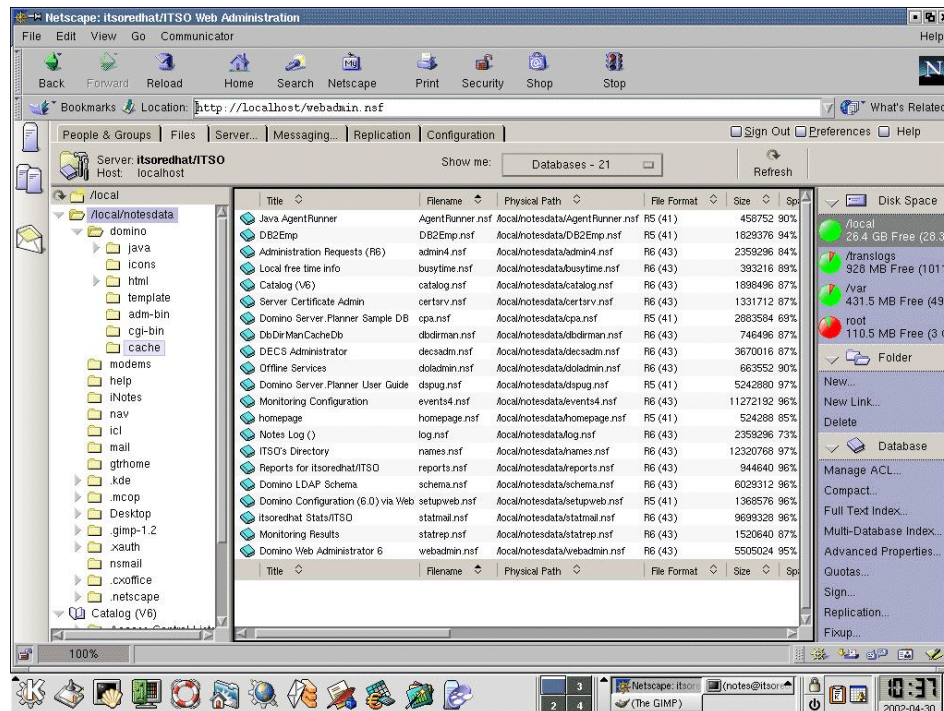


Figure 3-32 Domino 6 Web Administrator: Files view

On the Files tab, you can see and manage Domino databases and templates, as well as folders and links. You can perform many database management operations in this view, including compacting, signing and managing database ACLs, and viewing available disk space. These functions are all available via the Tools pane.

## Server tab

On the Server tab, the Domino 6 Web Administrator provides the Domino administrator with the ability to:

- Review several forms of server status
- Analyze server activities
- Review server statistics

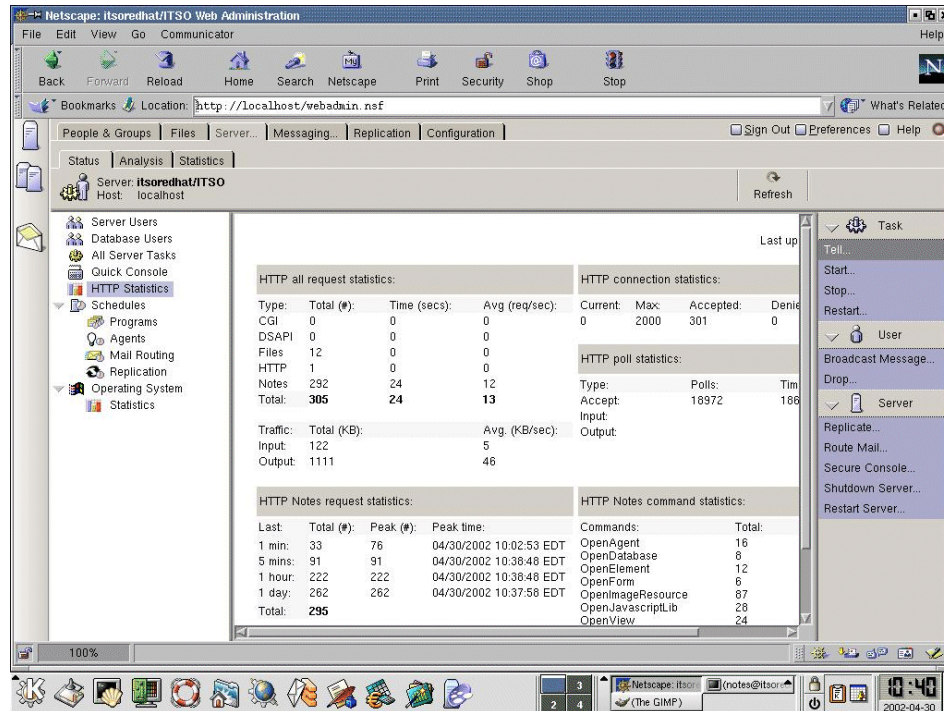


Figure 3-33 Domino 6 Web Administrator: Server status view

From the Server status view, you can see the status of different elements of your Domino environment. These elements include:

- ▶ Server users - shows who is using your Domino server.
- ▶ Database users - indicates which databases are being accessed on your Domino server, and by whom.
- ▶ Quick Console - allows you to issue console commands to the server.
- ▶ All server tasks - shows you a list of server tasks that are active.
- ▶ HTTP statistics - shows various statistics about your Domino Web server; an example statistics page is shown in Figure 3-33.
- ▶ Schedules - lets you view schedules for programs, agents, mail routing, and replication.
- ▶ Operation system statistics.

There are number of task you can perform by using the links in the Tools pane. These tasks include replicating databases and shutting down and restarting the Domino server.



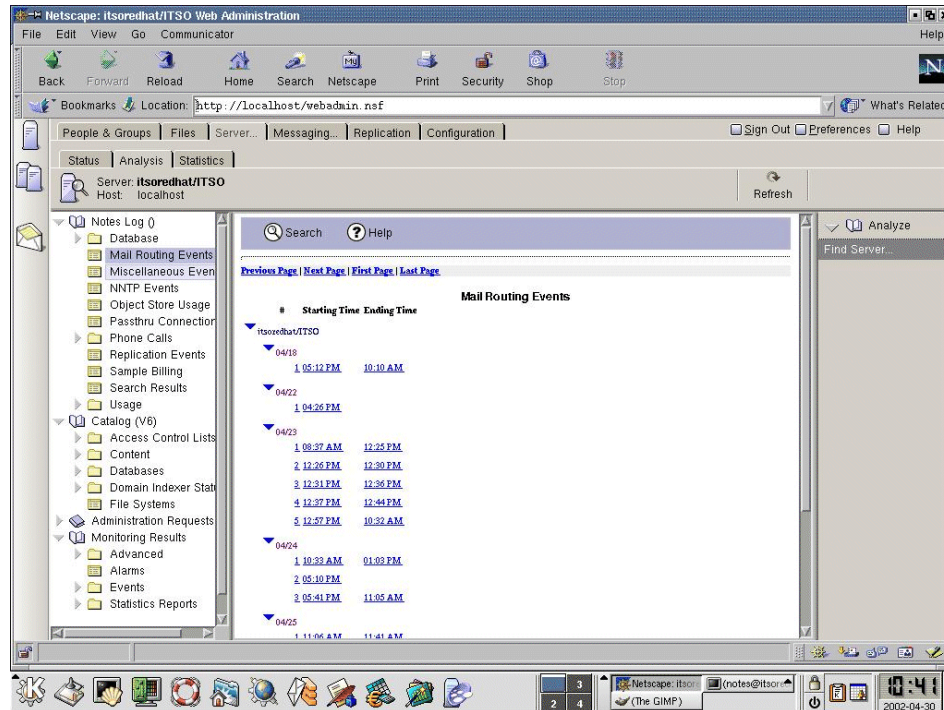


Figure 3-34 Domino 6 Web Administrator: Server analysis view

The Server analysis view provides you with sundry representations of information regarding databases, mail routing, replication, logs, and administration requests. See Lotus Domino Administration 6 help for further information about data analysis.

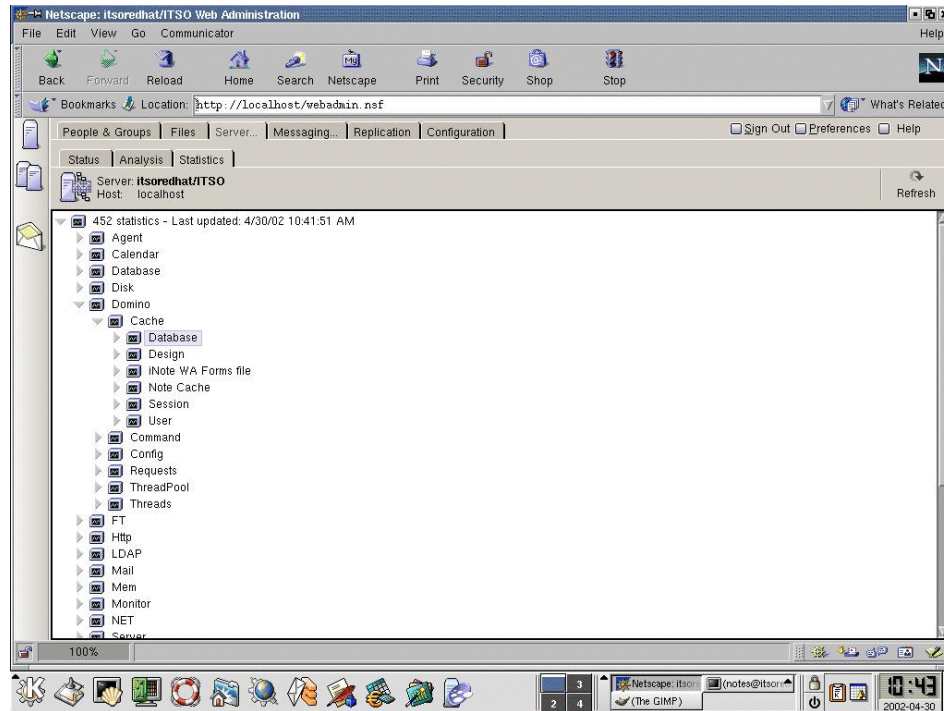


Figure 3-35 Domino 6 Web Administrator: Server statistics view

The final sub-tab of the Server tab is the Statistics tab, which shows you voluminous statistics about processes running on your system. These statistics include information about agents, databases, http, mail, and the server in general.

## Messaging tab

The Domino 6 Web Administrator provides the Domino administrator with the ability to manage every aspect of enterprise mail management from a Web browser. These tasks include:

- Mail server tasks
- Mail routing activities and events
- Mail reports

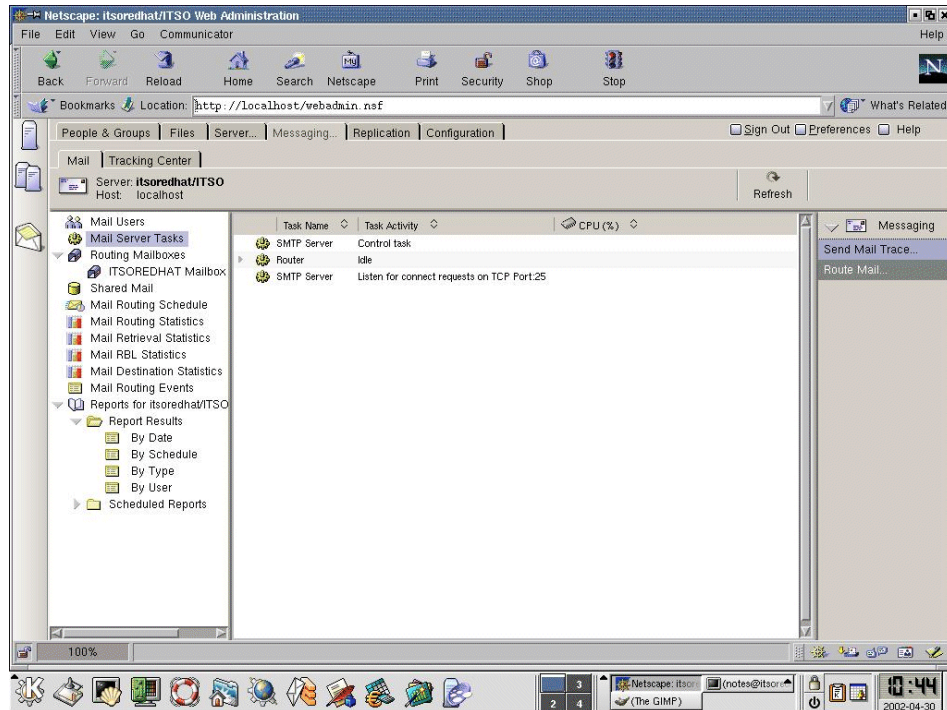


Figure 3-36 Domino 6 Web Administrator: Messaging mail view

Within the Messaging tab, you are able to manage the mailboxes on your server, check mail routing, monitor the logfile, run reports on various messaging usage criteria, and use the Tracking Center tab to track messages. In the window shown in Figure 3-36, you can see the Mail server tasks and the status of our Domino server.

## Replication

The Domino 6 Web Administrator enables the Web browser-based Domino administrator to control and manage the following replication activities:

- ▶ Replication tasks
- ▶ Replication schedules
- ▶ Replication events
- ▶ Replication statistics

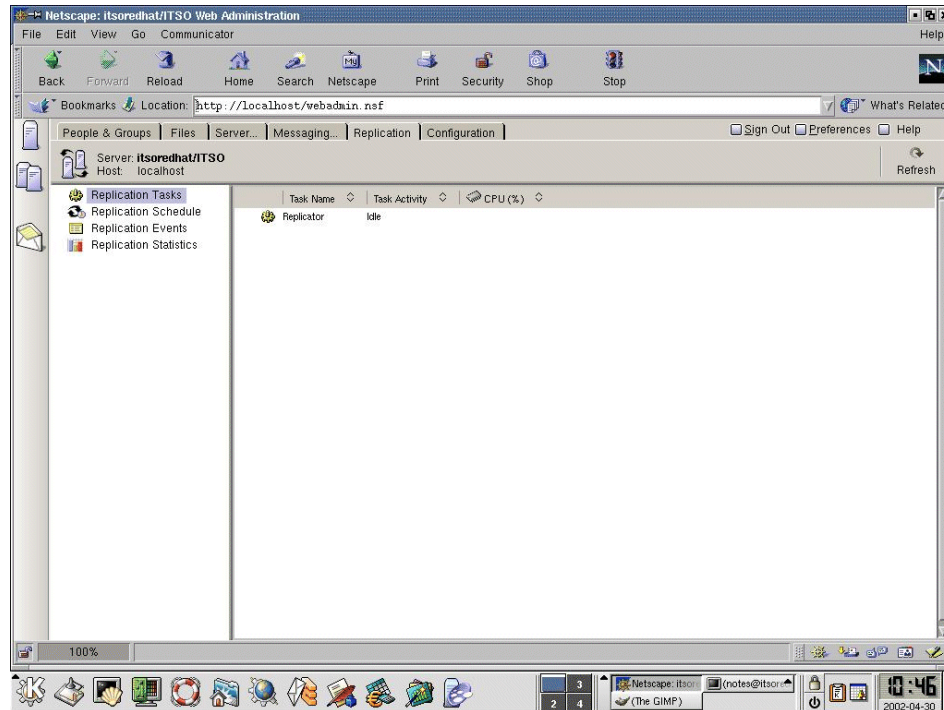


Figure 3-37 Domino 6 Web Administrator: Replication view

## Configuration

The Domino 6 Web Administrator provides the ability to control and modify several Domino server configuration options from a Web browser. The following configurations are available:

- Server documents, configurations, and connections
- Directory functions
- Web configuration
- Server monitoring
- Cluster management
- Miscellaneous



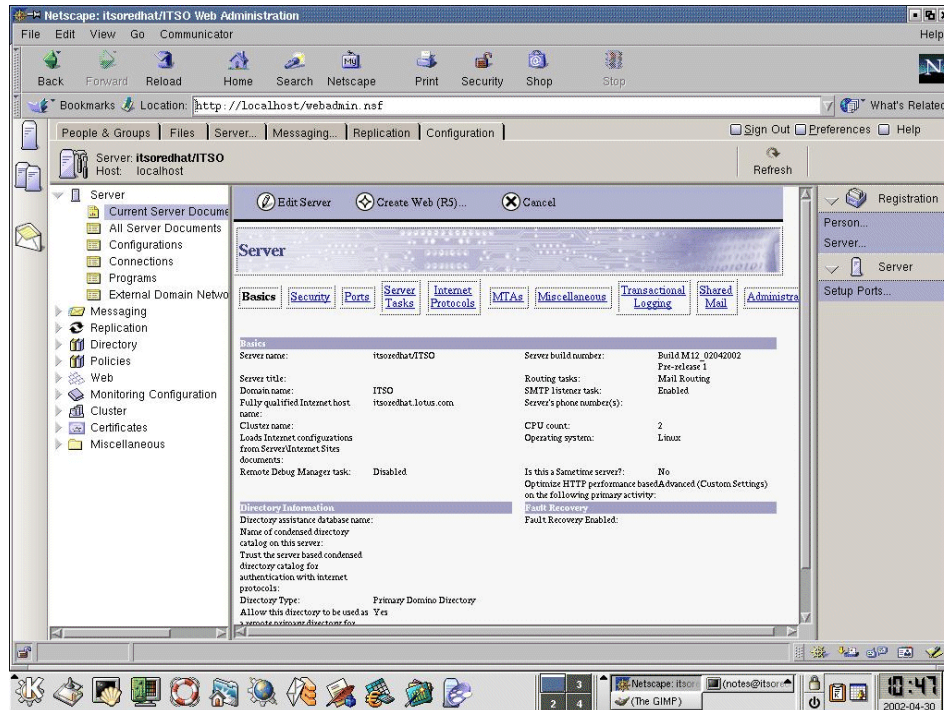


Figure 3-38 Domino 6 Web Administrator: Configuration view

One of the views available through the Configuration tab is the Current Server Document, which is shown in Figure 3-38. It provides access to your Domino server document, which contains many of the settings that define how your server operates. These settings include:

- ▶ Basic information, such as the server name and the host name of your server
- ▶ Security settings
- ▶ Internet protocols, such as settings for the HTTP task and Domino Web Engine
- ▶ Mail routing
- ▶ Transaction logging

### 3.4.2 Domino Java Console

The Domino Java Console provides real-time interaction with the Domino Server and is often the fastest way to see what is happening with a server. In Domino 6, the Domino Console is available through a new, powerful Java application. We covered the basics of enabling this tool in “Java Domino console” on page 126.

The advantage of the new Java Domino Console feature is that, unlike the Win32 Administration client, you can connect to the server Domino is installed on, even when the Domino server is not responding.

To launch the Domino console, do the following:

- ▶ On a Linux system running X-Windows, issue **jconsole** from a shell command prompt. If you have not added the Domino executable path to your PATH environment variable, you will need to specify the full location, which is /opt/lotus/bin by default.
- ▶ On a Windows machine with the Administration client installed, launch **jconsole.exe**. This executable is located in the Lotus Notes Client program directory.

Once the Domino Console launches, you can connect to a new server by **File - Connect Controller** (Ctrl-O). If you have previously connected to the server with this console, you can click the multiple server icon and select it from the list. In the prompt box, enter your Notes name (or shortname) as your username and your Domino HTTP password in the password field. For a new server, type the name in the server; otherwise, select the server from the drop-down list.

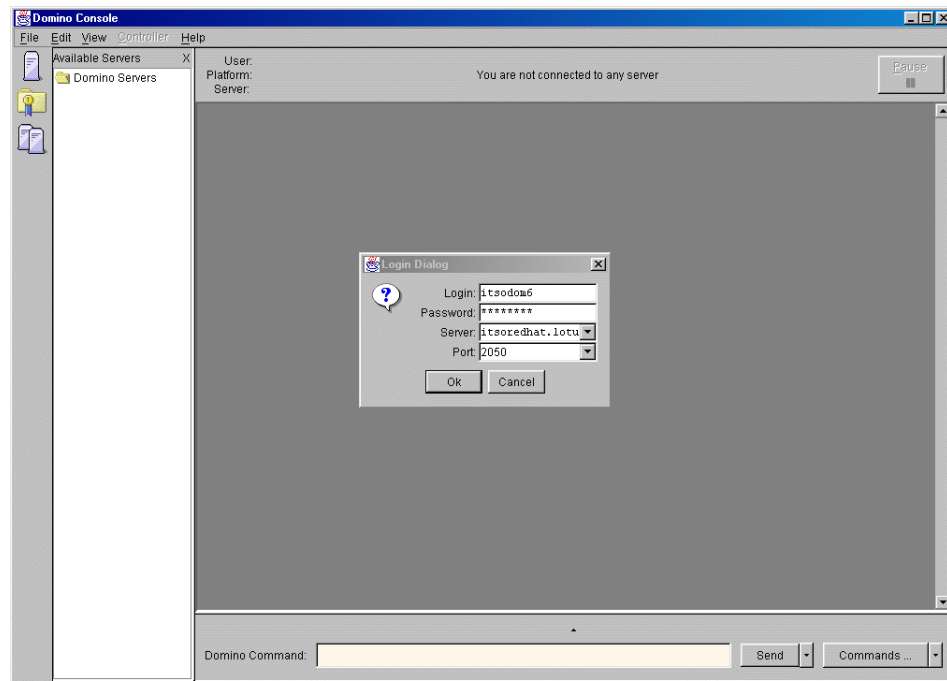


Figure 3-39 Domino Console: Connecting to a server

Table 3-3 identifies some of the common commands you can use from the console; these commands will also work from the Web admin quick console.

*Table 3-3 Common Domino Console commands*

<b>Domino Console command (abbreviation)</b>	<b>Description of the command results</b>
<b>show users (sh us)</b>	Shows the users connected to the Domino server
<b>show tasks (sh ta)</b>	Shows the tasks currently running
<b>show cluster (sh cl)</b>	Shows how the cluster is performing and current connectivity to cluster members
<b>show config servertasks</b>	Shows the current value of the servertasks notes.ini entry. You can use show config to display any notes.ini entry.
<b>set config servertasks=</b>	Replaces the existing server tasks notes.ini entry with the values you specify after the equals sign. The values you specify replace the existing ones (they are not appended).
<b>load replica</b>	Loads an instance of the replicator that remains until you reboot the server. Any load command without options loads another permanent instance of the task while a load command with options (see the next example) runs, then quits.
<b>replicate itsoredhat/ITSO names.nsf (rep itsoredhat/ITSO names)</b>	This causes the current server, itsosuse/ITSO in our case, to replicate the specified database, names.nsf, with the specified server, itsoredhat/ITSO. You must use the full hierarchical name of the server. Once replication finishes, the replicator will quit.
<b>show stat server.users</b>	Show stat displays the specified Domino statistic. There are hundreds of statistics; consult the event4.nsf database for a description of each statistic.
<b>restart server (res s)</b>	This will restart the Domino server. If issued from the Web admin quick console, you won't be able to view the restart. If issued from a client connected via the new controller, you can monitor the restart process.

Commands are entered into the Domino Command area at the bottom of the Domino console. For frequently used commands, you can click the **Command** button and select from a pre-defined list. Optionally, you can click the arrow to the right of the **Command** button and create a customized command list.

Here are the steps to record a customized command:

1. Click the arrow to the right of the **Command** button and select Customize.
2. In the Make a Custom Command dialog box, enter the desired command.
3. Click **Add** to add the command to your list.
4. Repeat Steps 2 and 3 until you have entered the commands for your list.
5. If you make a mistake or later desire to remove a command, highlight the command in the Make a Custom Command display and click **Remove** to remove it from your list.
6. Click **Save** to save and exit the dialog box.

You can now use your custom commands by clicking the arrow to the right of the **Command** button and picking the desired command from the list.

In addition to Domino commands, you can also send Shell commands as long as you have the appropriate access. Refer to **Help -> Help Topics** available with the Domino Console, or the Lotus Domino Administrator 6 help, for more information.



## Performance, scalability, and troubleshooting

This chapter discusses the performance and scalability of the Linux operating system and Domino 6. We describe how to measure CPU and memory with standard monitoring tools for Linux, such as `top`, `vmstat`, and `ksysguard`, as well as monitoring disk arrays. Next, we discuss altering the maximum number of threads available in Linux in order to provide high-end scalability. Finally, we present options for increasing the performance of your Domino 6 server.

## 4.1 Linux performance and scalability

Linux is a powerful operating system that can be molded to fit your needs. In this section we discuss hard disk drive arrays, CPU and memory monitoring, then give detailed instructions for significantly increasing the scalability of Linux supporting Domino.

### 4.1.1 Linux performance

There are a number of ways to tweak your server to gain more scalability and more flexibility.

#### IDE versus SCSI

The IDE bus is designed for normal PCs because it is simple to use, easy to implement in the PC, and inexpensive. SCSI bus is designed for professional use because it is faster than IDE, and you can attach more devices on the bus, such as hard disks, CD-ROMs, and so forth.

**Note:** We recommend you use SCSI hard disks for your servers.

#### Buses

Generally, your server will have two buses. You should split your heavily utilized cards, such as a primary network card and a RAID controller, so that they are installed in slots on different buses. In a typical IBM server, for example, you will see the buses designated as:

- ▶ Bus A, Bus B, and Bus C
- ▶ PCI and PCI/ISA
- ▶ Bus 0 and Bus 1

If you have a server with a 66 MHz (64 bit) bus and a 33 MHz (32 bit) bus, you will have better performance splitting your cards, even though one bus is slower. With significant I/O, the cards will benefit from working separately. If you put them all on the 66 MHz (64 bit) bus, they will compete and so necessarily diminish the overall throughput of that bus.

#### Distributing I/O

If you are running a program that is disk I/O intensive, such as a Domino server, we recommend that you use separate, physical disks for the OS, Domino data directory, and the Domino 6 transaction logs. If possible, use separate buses for disks as well. Example 4-1 shows a possible configuration for distributing I/O using three separate disks (sda, sdb, and sdc). The numbers on the end of the

disks (sda1, sda2) represent the partitions of that disk. For example, sda2 is the second partition of the first SCSI disk.

---

*Example 4-1 Distributing I/O*

---

```
/ -> /dev/sda1
swap -> /dev/sda2
/translogs -> /dev/sdb1
/local/notesdata -> /dev/sdc1
```

---

## **RAID configurations**

The main advantage of RAID is the redundancy. If one disk fails (for any reason), you will not lose your data. Another advantage is that you can stripe your data over multiple disks and gain speed for your applications. Striping will also balance the data across the disks. There are multiple RAID configurations:

- ▶ RAID 0 stripes your data over multiple disks; you gain speed, but you do not have redundancy.
- ▶ RAID 1 is called *mirror* because it writes the same data on two disks or more (with Enhanced RAID1 or RAID0+1). You have redundancy and the best reading speed because the system reads the data from the less busy disk.
- ▶ RAID 5 stripes the disks and writes the parity at the same time. This is the most used RAID configuration because it is a suitable compromise between speed and redundancy, with only a small cost in performance.

There are two types of RAID: software and hardware.

### **Software RAID**

Software RAID is done at the OS level. It is a layer between the physical disks and applications. Since software RAID uses the main processor and the main memory for calculation of the parity, these resources are not available to Domino.

**Note:** For more information about how to build a software RAID in Linux, read the “Software RAID” HOW-TO document. You can find this HOW-TO document, as well as numerous others, on The Linux Documentation Project Web site at:

<http://tldp.org/docs.html>

### **Hardware RAID**

Hardware RAID is provided by a SCSI or IDE controller. The disks are connected directly to the RAID controller. This is transparent even to the OS. The OS “sees” only one drive. Before you install the OS, you need to create the RAID array. The

hardware RAID controller has its own processor and RAM for parity calculation, thus providing much better performance.

### **Hardware RAID versus software RAID**

Table 4-1 identifies some differences between hardware and software RAID.

*Table 4-1 Hardware versus Software RAID*

Description	RAID SW	RAID HW
Use system CPU and memory?	yes	no
Transparent to the OS?	no	yes
Transparent to an application?	yes	yes
Can use IDE and SCSI hard disks within the same area?	yes	no
Is it OS independent?	no	yes*
Can use disk on different buses?	yes	no
Can use fraction of the disks?	yes	yes

\* Only if you have the drivers for the OS

See more discussion about RAID and recommendations for your Domino for Linux server in “Transaction logging” on page 229.

### **Logical Volume Manager**

The Logical Volume Manager (LVM) is a new feature in Linux. It is a layer between the physical hard disk, or RAID controller, and the application. By using the LVM you gain:

- ▶ Flexibility - you can modify the partition on the fly without unmounting the partition
- ▶ Speed - by striping the logical volume
- ▶ Redundancy - by mirroring the logical volume

The structure of LVM is shown in Figure 4-1.



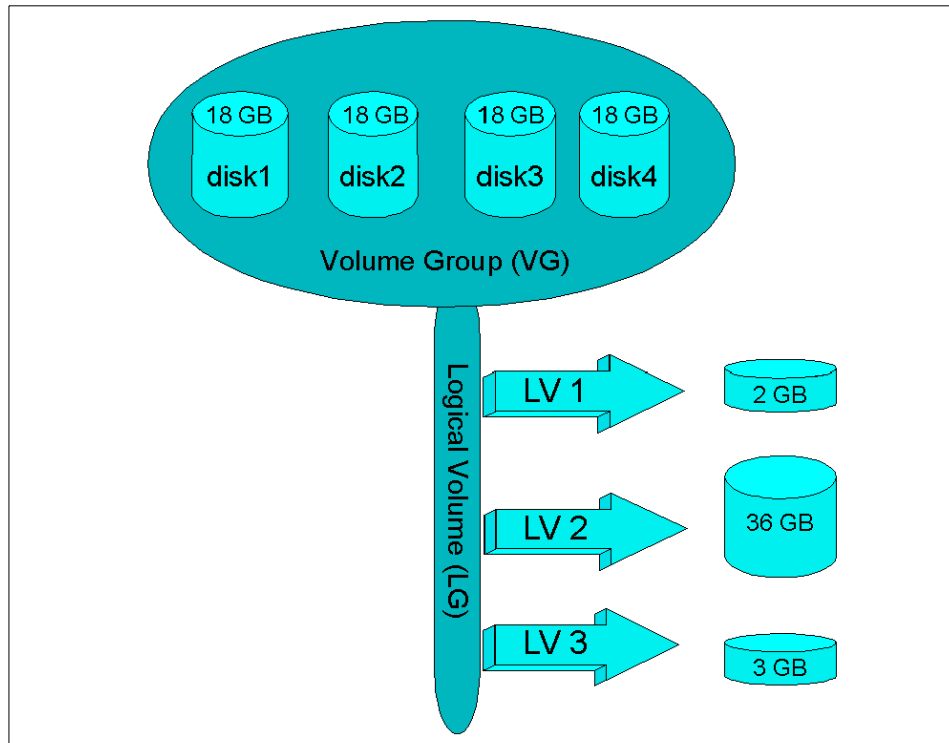


Figure 4-1 LVM structure

**Note:** For more information about LVM and how to install it on Linux, read the LVM HOW-TO. You can find this HOW-TO document, as well as numerous others, on The Linux Documentation Project Web site at:

<http://tldp.org/docs.html>

## CPU utilization

You can monitor the CPU utilization with the **top** tool from the command line; if you prefer a graphical tool use KDE System Guard described on page 202. It is very useful if you have more than one processor. The results of the **top** command are shown in Figure 4-2 on page 200.

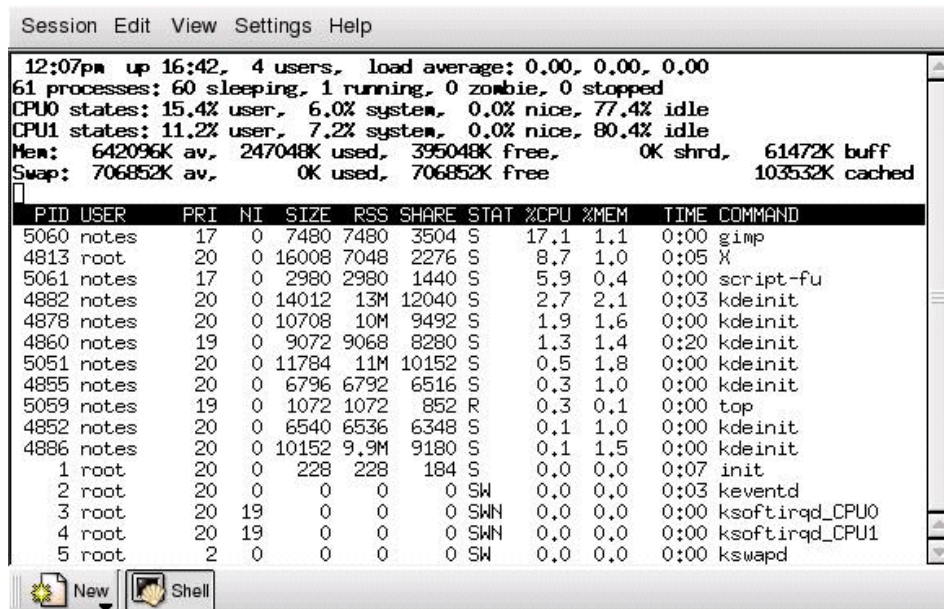


Figure 4-2 Top view

We recommend that you monitor the CPU utilization regularly. If the average value is between 60 and 80 percent, you have reached the warning zone. If average usage exceeds 80 percent, we recommend that you add a new processor or upgrade the old one.

## Memory usage

Memory is arguably the most important hardware in a system. We recommend you use ECC (Error Checking and Correcting) memory or newer technology when possible.

Linux uses memory efficiently. If you see the swap constantly in use, this indicates a lack of physical memory and your server performance will suffer.

Linux has a tool, called **vmstat**, to monitor memory and CPU usage; you can also use KDE System Guard. With the help of this tool, you can monitor the server performance over a long period of time. Figure 4-3 on page 201 shows the information vmstat produces. Note that the CPU usage statistics are averaged across all CPUs in the server.

```

Session Edit View Settings Help
notes@itsosuse:~$ vmstat 1
procs
r  b  w    swpd   free   buff   cache    si   so    bi    bo    in    cs    us    sy    id
0  0  0      0 391612 61812 104144    0    0    1    1    52    5    0    0 100
0  0  0      0 391612 61812 104144    0    0    0    0   104   103    2    0 98
0  0  0      0 391616 61812 104144    0    0    0    0   247   770    2    0 98
0  0  0      0 391612 61812 104144    0    0    0    0   240   552    1    0 98
0  0  0      0 391612 61812 104144    0    0    0    0   159   363    0    0 100
0  0  0      0 391608 61816 104144    0    0    0    0   24   112   115    0    1 99
0  0  0      0 391608 61816 104144    0    0    0    0    104    89    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   103    87    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   102    87    0    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   103    85    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    9   106    94    0    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   104    91    0    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   105   100    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   105    83    0    0 99
0  0  0      0 391608 61816 104144    0    0    0    4   106    93    0    1 99
0  0  0      0 391608 61816 104144    0    0    0    0   136    84    0    0 100
0  0  0      0 391608 61816 104144    0    0    0    0   106    98    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   105    85    1    0 99
0  0  0      0 391608 61816 104144    0    0    0    0   104    87    0    0 99

```

Figure 4-3 **vmstat** output

The columns in the vmstat output have the following meanings:

- r**           The number of processes waiting for run time.
- b**           The number of processes in uninterruptable sleep.
- w**           The number of processes swapped out but otherwise runnable. This field is calculated, but Linux never desperation swaps.
- swpd**       The amount of virtual memory used (kB).
- free**       The amount of idle memory (kB).
- buff**       The amount of memory used as buffers (kB).
- si**          Amount of memory swapped in from disk (kB/sec).
- so**          Amount of memory swapped to disk (kB/sec).
- bi**          Blocks sent to a block device (blocks/sec).
- bo**          Blocks received from a block device (blocks/sec).
- in**          The number of interrupts per second, including the clock.
- cs**          The number of context switches per second.
- us**          User time.
- sy**          System time.

**id** Idle time.

Example 4-2 is a sample script that runs the **vmstat** command to gather usage information and save it in a file. In this way, administrators can utilize the statistics about memory usage and CPU usage to gauge if the server is heavily utilized. To use this script, create and save the script, then set it to run periodically using **crontab**. (Find more details about how to do this in 3.2.4, “Crontab” on page 156, and “Scripts” on page 154.)

---

*Example 4-2 vmstat.sh*

---

```
#!/bin/bash

FILE_NAME=/var/log/vmstat.log
NR_OF_SEC=2 # Time between reading
WAIT_TIME=10 # The number is in sec.

echo "#####" >> $FILE_NAME
echo "#####" >> $FILE_NAME
echo "" >> $FILE_NAME
date >> $FILE_NAME
echo "-----" >> $FILE_NAME
vmstat $NR_OF_SEC >> $FILE_NAME &
echo "" >> $FILE_NAME
sleep $WAIT_TIME
for i in `ps ax|grep vmstat | awk '{print $1}'`
do
kill -9 $i > /dev/null
done
```

---

## KDE System Guard

KDE System Guard is equivalent to Windows Task Manager and Windows Performance Monitor in one tool. The Windows Task Manager Performance and Networking tabs are similar to the System Guard System Load and Process Tables. (see Figure 4-5 on page 204 and Figure 4-6 on page 205). The Windows Performance Monitor is similar to System Sensors (see Figure 4-11 on page 208).

To start KDE System Guard, click **Start -> System -> Info -> KDE System Guard** on SuSE, or **Start -> System -> KDE System Guard** on Red Hat; see Figure 4-4 on page 203.

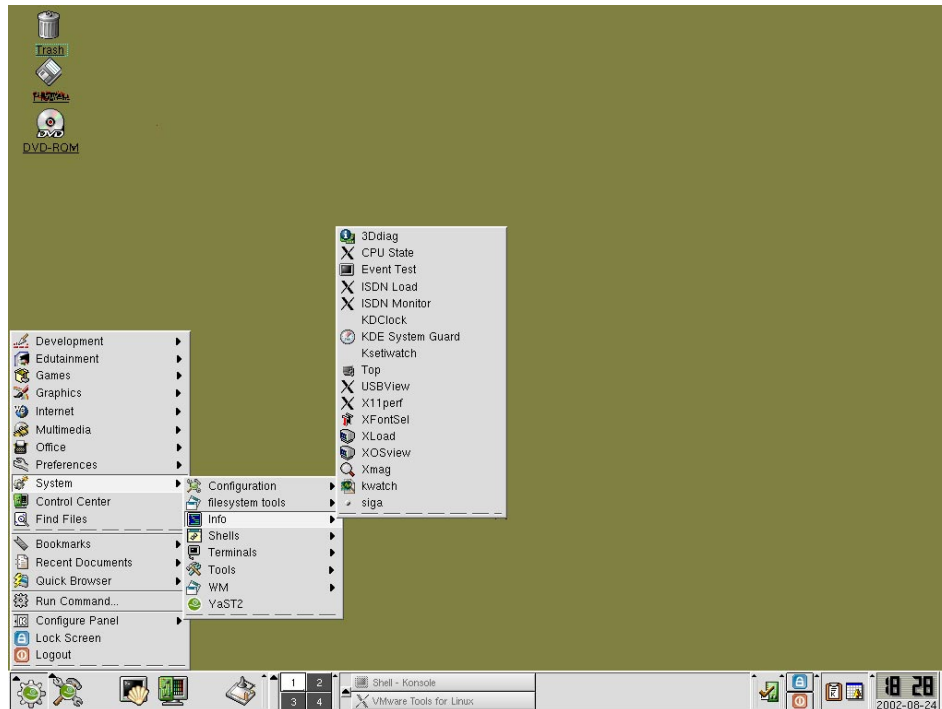


Figure 4-4 Starting KDE System Guard

### System load

The System Load tab of the KDE System Guard tool provides a lot of different statistics and information about the utilization of system resources, such as CPU, memory, and swap. Figure 4-5 on page 204 shows you some of the statistics available in the system load tab.

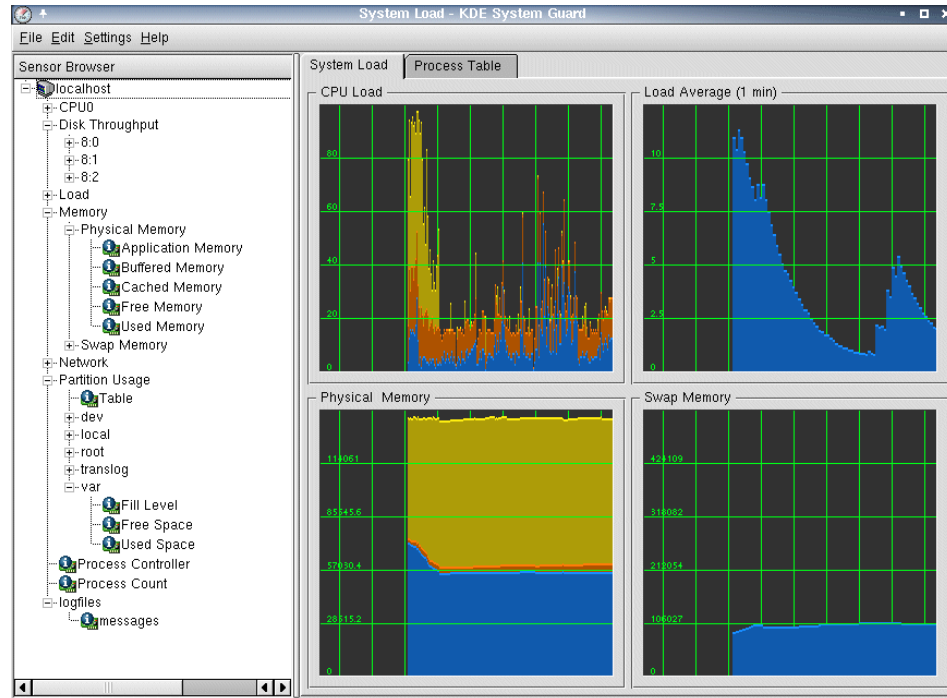


Figure 4-5 System load

### **Process table**

Click the Process Table tab to see a list of running processes, as shown in Figure 4-6.

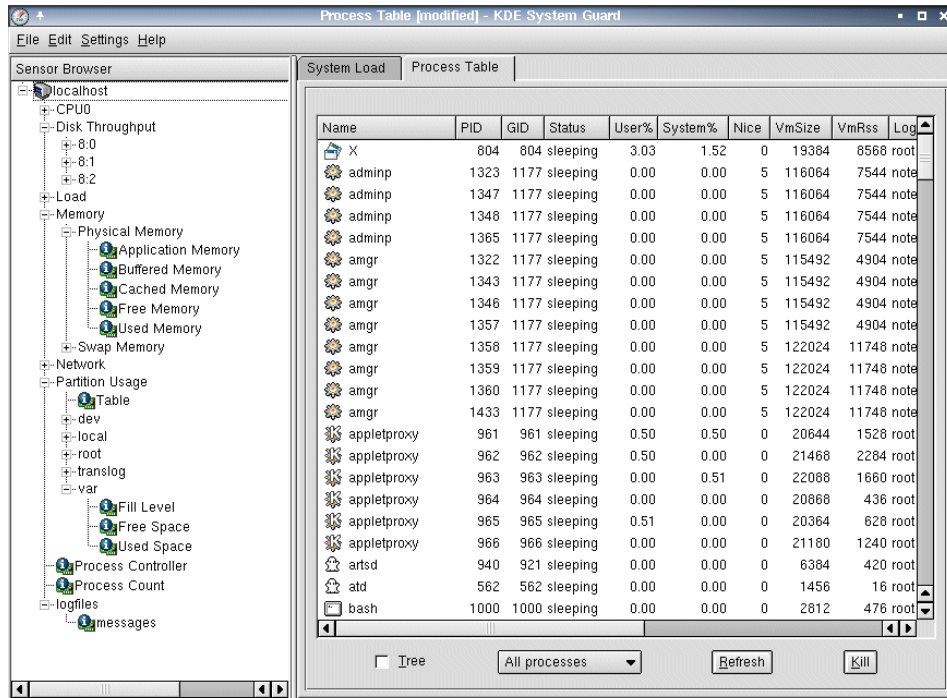


Figure 4-6 Process table

The process table shows you the tasks on your Linux server and various details about the services, such as the status, memory usage, who started the process, and so forth.

The Tree check box at the bottom of the screen shows what processes have been started as child processes, and which therefore may fail if you kill a parent process. (This function is not available in Windows Task Manager.) The “Processes” drop-down list, also at the bottom of the screen, lets you choose to see all process, the processes that belong to the system, processes that belong to users, or just your own processes (see Figure 4-7).

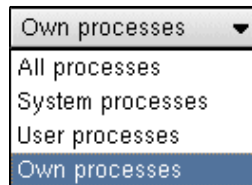
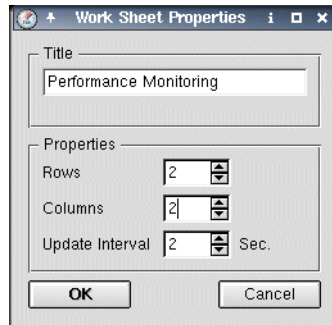


Figure 4-7 Processes

The Kill button allows you to kill selected processes; this is equivalent to End Process in Windows Task Manager.

### ***Performance monitoring***

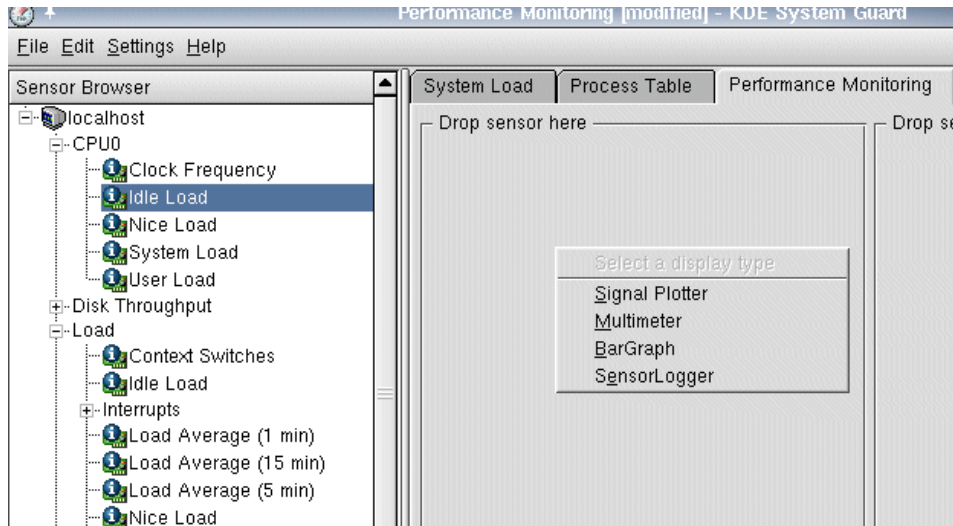
To create a new worksheet, select **File -> New**. The dialog box shown in Figure 4-8 is displayed.



*Figure 4-8 New worksheet*

The number of row times the number of columns yields the number of monitors you can set up; the update interval is how often the information is collected.

Now drag and drop one of the sensors from the Sensor Browser to the worksheet, as shown in Figure 4-9.



*Figure 4-9 Drag and drop sensor*



Select the display type of the sensor (see Figure 4-9). Examples of the different display types are show in Figure 4-11 on page 208.

A Multimeter or a Bar Graph just shows the current information, while a Signal Plotter is a scrolling graph.

A SensorLogger logs the information to a file that can be accessed later (see Figure 4-10).

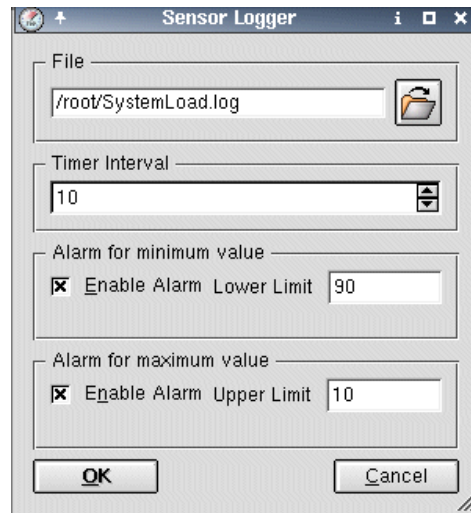


Figure 4-10 Sensor Logger

The sensor Logger requires a file name to store the information in and an interval timer (how often to collect the information). Optionally, you can add an upper and lower alarm limit (the logger line turns a different color). By default the logger is not running; to start the logger right-click the **X** and select **Start Logger** (see Figure 4-11).

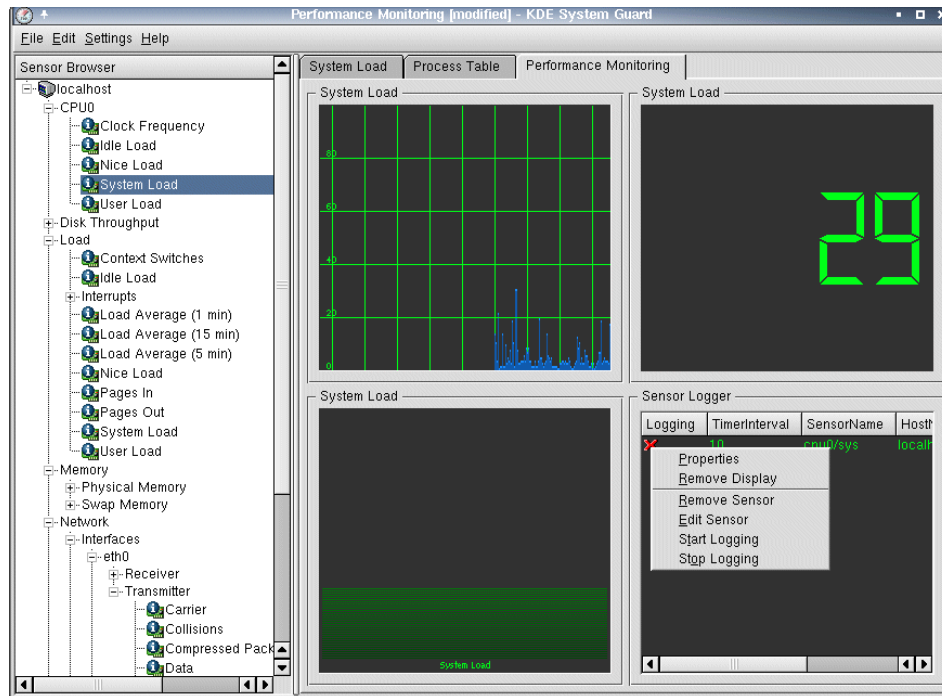


Figure 4-11 Sensor types

## 4.1.2 Linux scalability

This section outlines changes you can make to your Linux OS to customize it for maximum Domino 6 server performance. First, we cover the easily tunable kernel limits, then we discuss a slightly more complex undertaking—recompiling glibc in order to alter the hard-coded thread limit. We have detailed the steps for both Red Hat 7.2 and SuSE 8.0.

**Attention:** Modifications to the Linux kernel, or compiling any Linux libraries such as glibc, are not supported by Lotus software.

**Note:** With Domino R5 the supported Linux kernel versions are 2.2 and 2.4. At present, Domino 6 only supports the 2.4 kernel.

Refer to the Release Notes of your Domino version for details about the required kernel and patch levels.

## Enhancing Domino server performance

This section describes some changes you can make to enhance the performance of Domino 6 on Linux.

First, the `sysctl.conf` file is used with the 2.4 kernel to set tunable parameters. This file can be edited with any text editor; in this example we describe the procedure using the versatile *KATE*. You will need to be logged in to KDE as root in order to save the file into `/etc`.

1. Start the text editor program in Red Hat 7.2 by clicking **Start Application -> Editors -> Kate**; in SuSE 8.0 click **Start Application -> Office -> Editors -> Kate**.

We need to see if there is an existing `/etc/sysctl.conf` file.

- a. Click **File -> Open**.

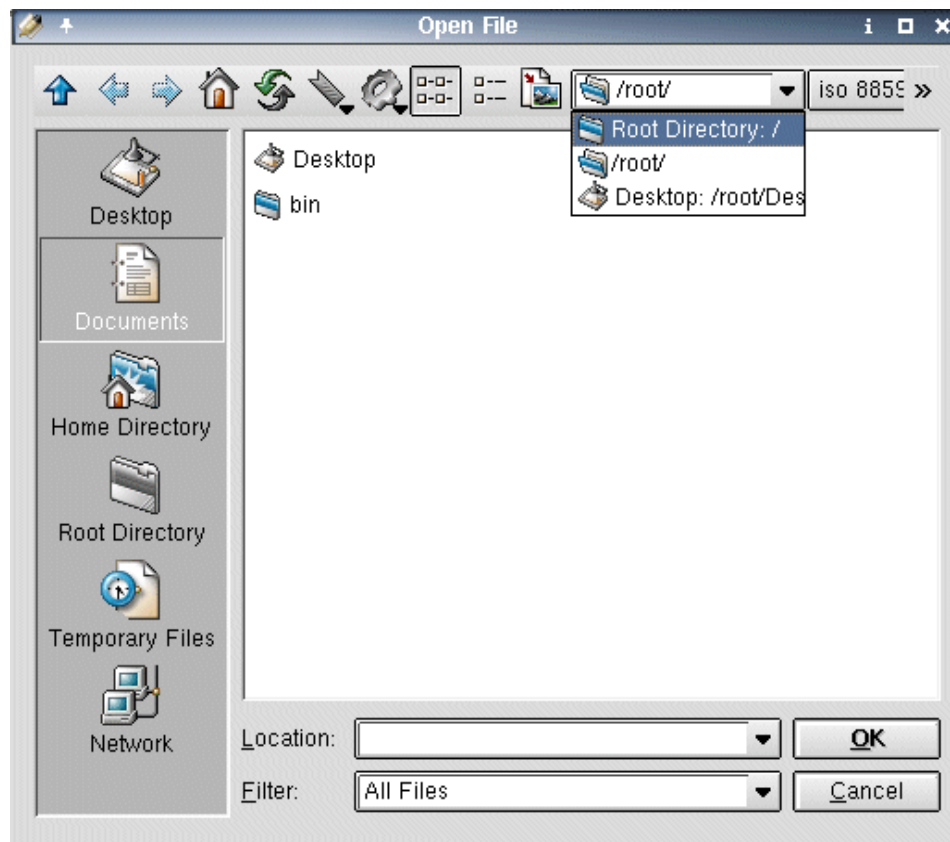


Figure 4-12 Select root directory

- b. Click **Root Directory** from the drop-down box shown in Figure 4-12.
  - c. Click **etc**.
  - d. If you see the `sysctl.conf` file listed, click it, then click **OK** to open it. Otherwise, use the new file that KATE opens by default.
2. Determine the current `file-max`, found in `/proc/sys/fs/file-max`; it is typically set to a value of 49152 or higher. You can open the file with KATE or from a shell prompt with **more /proc/sys/fs/file-max**. We used this value to set an upper file limit in Steps 3 and 5, and then allowed Domino to use up to the maximum value.

**Note:** Sometimes the warning message “File has changed on disk” appears. Just click to cancel it.

3. Here are the lines that need to be included in the `sysctl.conf`:

```
fs.file-max=49152
kernel.shmni=8192
```

For the `fs.file-max` line, use the value from Step 2 or 49152, whichever is greater.

For Red Hat 7.2, you need to add an additional line:

```
kernel.sem=250 18432 32 1024
```

As with the `file-max` parameter, you can view the existing value with **more /proc/sys/fs/kernel.sem**. If any of the existing values are greater than the ones specified here, use the higher value.

4. Verify that if the file `/proc/sys/kernel/threads-max` exists, it is set to a value of 8192 or higher. You can open the file using KATE or from a shell prompt with **more /proc/sys/kernel/threads-max**. If the number is not greater than 8192, your system will be limited by the given value. This number is determined dynamically by the OS and is typically 8192 or higher. You can override it by setting a new value (`kernel.threads-max=8192` in the `sysctl.conf` file), but doing so could have an adverse affect on your system's stability.
5. Next, edit `/etc/security/limits.conf` and add the following four lines for the notes account used to run Domino, which in our case is `itsodom6`.

```
itsodom6    soft  nofile  49152
itsodom6    hard  nofile  49152
itsodom6    soft  nproc   8192
itsodom6    hard  nproc   8192
```

Again, you should use the value from Step 2 or 49152, whichever is greater, for the hard nofile limit.

Repeat these four lines for each Domino partition you have. For example, if you have 2 partitions – the first partition run by npar1 and the second by npar2 – then your limits.conf file would look like this:

```
npar1    soft  nofile  49152
npar1    hard  nofile  49152
npar1    soft  nproc   8192
npar1    hard  nproc   8192
npar2    soft  nofile  49152
npar2    hard  nofile  49152
npar2    soft  nproc   8192
npar2    hard  nproc   8192
```

These limits are applied only to the Linux account used to run Domino and do not apply to any other account on the system. The two flags increase the maximum number of open files (nofile) and the maximum number of processes/threads (nproc) allowed for the user(s).

6. Check that /etc/pam.d/login has the following line:

```
session required /lib/security/pam_limits.so
```

7. Edit the file /etc/fstab and add the noatime parameter to the options of the file system(s) on which your Domino data directories reside; in this example we use the /local file system. This disables tracking of the access time, which is a value that Domino never uses, and will increase performance.

```
/dev/sdc1  /local  ext3      defaults,noatime  1    2
```

In this example, we added a comma and the noatime parameter after the existing defaults parameter.

Once these settings have been made, reboot your system to put them to work for you.

## Red Hat 7.2 - glibc-2.2.4-13

With the existing Domino architecture on Linux, in order to truly scale Linux to thousands of concurrent users, we need to alter and recompile the linuxthreads portion of glibc on this version of Red Hat. Following are the steps to alter the pthread limit for Red Hat 7.2 or 7.3; you will need to be root in order to carry out these steps. Unlike Domino R5 for Linux, Domino 6 takes advantage of the variable stack size provided by glibc, and so you do not need to alter the stack size of glibc. Though there are quite a few steps, we have detailed them carefully so that even those relatively new to Linux should be able to make this alteration.

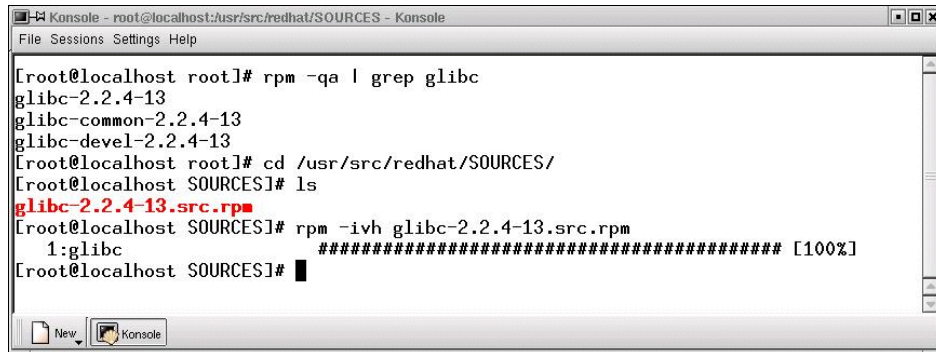
**Note:** Once you recompile glibc, you will be using a separate version stored locally and any glibc patches subsequently applied to the operating system will not be in effect for the version loaded with Domino. In order to get those patches to be included in the version load for Domino, you need to alter the PTHREAD setting and recompile. In general, this only needs to be done either when you upgrade the operating system from one major version to the next, such as RedHat 7.2 to 7.3, install a patch from RedHat with a newer version of glibc, or when Domino fails to start with the customized library but starts fine without it.

### ***Install the glibc-2.2.4 source files***

1. Check for the version of glibc on your Linux system by issuing the command:

```
rpm -qa | grep glibc
```

This queries all packages and sends the output to the **grep** program, which searches for the value specified, in this case glibc. You should see output similar to that shown at the top of Figure 4-13.

A screenshot of a terminal window titled 'Konsole - root@localhost:usr/src/redhat/SOURCES - Konsole'. The terminal shows the following commands and output:

```
[root@localhost root]# rpm -qa | grep glibc
glibc-2.2.4-13
glibc-common-2.2.4-13
glibc-devel-2.2.4-13
[root@localhost root]# cd /usr/src/redhat/SOURCES/
[root@localhost SOURCES]# ls
glibc-2.2.4-13.src.rpm
[root@localhost SOURCES]# rpm -ivh glibc-2.2.4-13.src.rpm
1:glibc ##### [100%]
[root@localhost SOURCES]#
```

Figure 4-13 RPM query output for Red Hat 7.2

2. While glibc is installed with Linux, the source code is not installed by default. Therefore, we need to install the source files so that we can adjust the definitions. You can install the source files from the third Red Hat 7.2 CD, or you can download the appropriate glibc source code from the Internet. The source code you download should match the installed version, which is 2.2.4-13 for the standard Red Hat 7.2 distribution.

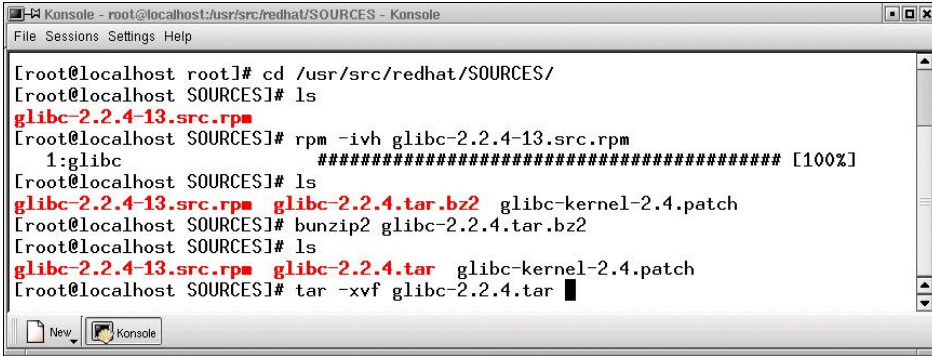
**Attention:** If you do not use the version of source from the same origination as your original glibc, then you may miss any patches which the vendor has made, and therefore you may run the risk of destabilizing your system.

3. To install the files, you need to `cd` to the appropriate location and type:

```
rpm -ivh glibc-2.2.4-13.src.rpm
```

If you are upgrading a different version of `glibc`, make certain to replace 2.2.4-13 with the correct version number.

4. Change directories with `cd /usr/src/redhat/SOURCES/` and you should now see the file `glibc-2.2.4-13.tar.bz2` located in this directory. Since the file ends with `.bz2`, it has been compressed with `bzip2` and can be decompressed with `bunzip2 glibc-2.2.4.tar.bz2`



```
Konsole - root@localhost:/usr/src/redhat/SOURCES - Konsole
File Sessions Settings Help

[root@localhost root]# cd /usr/src/redhat/SOURCES/
[root@localhost SOURCES]# ls
glibc-2.2.4-13.src.rpm
[root@localhost SOURCES]# rpm -ivh glibc-2.2.4-13.src.rpm
1:glibc ##### [100%]
[root@localhost SOURCES]# ls
glibc-2.2.4-13.src.rpm glibc-2.2.4.tar.bz2 glibc-kernel-2.4.patch
[root@localhost SOURCES]# bunzip2 glibc-2.2.4.tar.bz2
[root@localhost SOURCES]# ls
glibc-2.2.4-13.src.rpm glibc-2.2.4.tar glibc-kernel-2.4.patch
[root@localhost SOURCES]# tar -xvf glibc-2.2.4.tar
```

Figure 4-14 Decompress and unpack files

5. After decompressing the file, you need to unpack it. You can do this with the `tar` command `tar -xvf glibc-2.2.4.tar` shown in Figure 4-14.

### **Change one `glibc-2.2.4` header file**

1. The `tar` command creates a new directory, `glibc-2.2.4` in the `SOURCES` directory. We need to edit one file in this directory, and since we are running X-Windows and using KDE on Red Hat 7.2, we are going to use the Kate editor.
  - a. Click **Start Application -> Editors -> Kate**.
  - b. Click **File -> Open**.
  - c. Starting with the `/` directory (and not the root home directory, which is `/root`) click **usr**, **src**, **redhat**, **SOURCES**, **glibc-2.2.4**, **linuxthreads**, **sysdeps**, **unix**, **sysv**, **linux**, and **bits**. There are only a few files in this directory.
  - d. Click **local\_lim.h** and click **OK** to open the file, as shown in Figure 4-15.

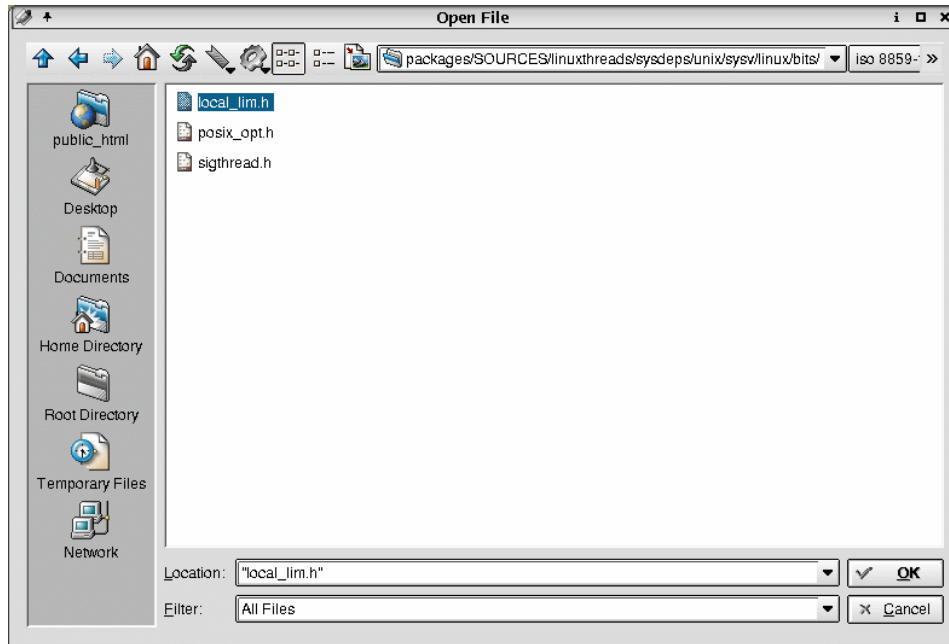


Figure 4-15 Kate Open file dialog box for *local\_lim.h*

2. With the file open, you need to locate the appropriate PTHREAD\_THREADS\_MAX line shown in Figure 4-16. The steps are:
  - a. Click **Edit -> Find**.
  - b. Enter PTHREAD\_THREADS\_MAX for the text to find.
  - c. Check the **Case Sensitive** option.
  - d. Click **OK**.



```

/* The number of threads per process. */
#define _POSIX_THREAD_THREADS_MAX.      64
/* This is the value this implementation supports. */
/* #define PTHREAD_THREADS_MAX 1024 */
#define PTHREAD_THREADS_MAX.            8192

/* Maximum amount by which a process can decrease its asynchronous I/O priority level.*/
#define AIO_PRIO_DELTA_MAX.              20

/* Minimum size for a thread. We are free to choose a reasonable value. */
#define PTHREAD_STACK_MIN.               16384

/* Maximum number of POSIX timers available. */
#define TIMER_MAX.                       256

```

Figure 4-16 Change to `local_lim.h` for Red Hat 7.2

3. Comment out the line:

```
#define PTHREAD_THREADS_MAX 1024
```

by adding the C-style programming multi-line comment characters so it looks like this:

```
/* #define PTHREAD_THREADS_MAX 1024 */
```

4. Below the line you just commented out, enter:

```
#define PTHREAD_THREADS_MAX 8192
```

This will increase the per-process Posix thread limit from 1024 to 8192.

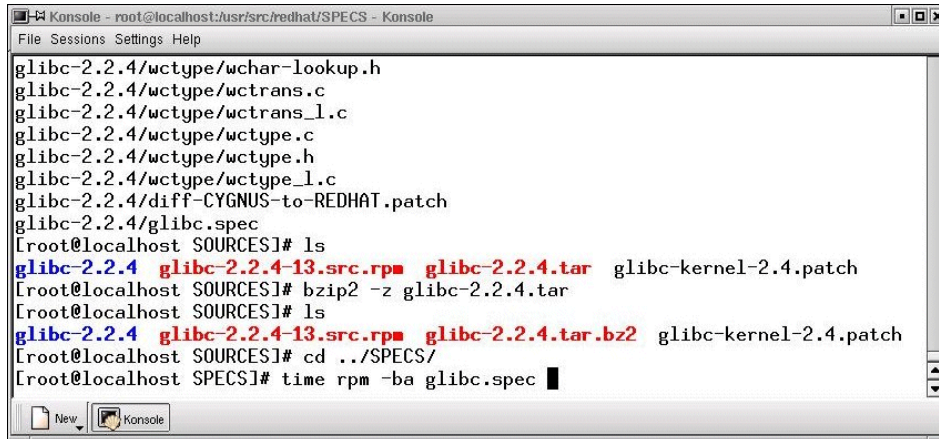
5. Save and close the file.

### **Build glibc-2.2.4 with the changes**

1. Now that you have edited the file, you need to replace the existing tar file with the new version that includes your adjustments.
  - a. Return to the SOURCES directory with `cd /usr/src/redhat/SOURCES`.
  - b. Enter `rm -f glibc-2.2.4.tar` to delete the file. The `-f` switch merely suppresses the text prompt to confirm deletion; you can use the command without `-f` if you prefer to be prompted.
  - c. Enter `tar -cvf glibc-2.2.4.tar glibc-2.2.4` to pack the files.
  - d. Enter `bzip2 -z glibc-2.2.4.tar` to compress the tar file.
2. Change to the SPECS directory with `cd ../SPECS` or by specifying the full path of `/usr/src/redhat/SPECS`. To build the new linuxthread files you need, enter the following command:

```
rpm -ba glibc.spec
```

**Tip:** This took approximately one hour on the test servers in our lab. You can preface the command with **time** to measure how long it takes.



```
Konsola - root@localhost:/usr/src/redhat/SPECS - Konsola
File Sessions Settings Help


glibc-2.2.4/wctype/wchar-lookup.h
glibc-2.2.4/wctype/wctrans.c
glibc-2.2.4/wctype/wctrans_1.c
glibc-2.2.4/wctype/wctype.c
glibc-2.2.4/wctype/wctype.h
glibc-2.2.4/wctype/wctype_1.c
glibc-2.2.4/diff-CYGNUS-to-REDHAT.patch
glibc-2.2.4/glibc.spec
[root@localhost SOURCES]# ls
glibc-2.2.4 glibc-2.2.4-13.src.rpm glibc-2.2.4.tar glibc-kernel-2.4.patch
[root@localhost SOURCES]# bzip2 -z glibc-2.2.4.tar
[root@localhost SOURCES]# ls
glibc-2.2.4 glibc-2.2.4-13.src.rpm glibc-2.2.4.tar.bz2 glibc-kernel-2.4.patch
[root@localhost SOURCES]# cd ../SPECS/
[root@localhost SPECS]# time rpm -ba glibc.spec
```

Figure 4-17 Building glibc-2.2.4

3. The two new share object files (Linux equivalent to Windows dll files) will be located in the `/usr/src/redhat/BUILD/glibc-2.2.4` directory in the following sub-directories:

`build-i386-linux/linuxthreads/libpthread.so`

`build-i386-linux/rt/librt.so`



```
Konsola - root@localhost:/usr/src/redhat/BUILD - Konsola
File Sessions Settings Help

[root@localhost root]# cd /usr/src/redhat/BUILD/
[root@localhost BUILD]# find . -name libpthread.so
./glibc-2.2.4/build-i386-linux/linuxthreads/libpthread.so
[root@localhost BUILD]# find . -name librt.so
./glibc-2.2.4/build-i386-linux/rt/librt.so
[root@localhost BUILD]#
```

Figure 4-18 Location of two required files

**Tip:** The **find** command locates files anywhere in the directory tree. In the example shown in Figure 4-18, the **.** tells the program to start with the current directory and descend into all subdirectories. The **-name** switch tells **find** to look for a filename matching the specified name. If you did not know the file's location or full name, you could issue the command **find / -name lib\*** to have **find** search every directory for files beginning with **lib**. This, along with its other abilities, makes **find** a powerful administration tool.

### ***Load the new thread library***

1. Change to your Domino data directory. The default is **cd /local/notesdata**.
2. Issue the command **mkdir lib** to create a directory for the new files and **cd lib** to change to the newly created directory.
3. Copy the new **libpthread.so** and **librt.so** from the BUILD directory.

```
cp /usr/src/redhat/BUILD/glibc-2.2.4/build-i386-linux/linuxthreads
libpthread.so ./libpthread.so.Domino
```

```
cp /usr/src/redhat/BUILD/glibc-2.2.4/build-i386-linux/rt librt.so
./librt.so.Domino
```

**Important:** After building **glibc-2.2.4**, you now have two versions of **libpthread.so** and **librt.so**. Make certain you copy the files from the **/usr/src/redhat/BUILD** directory and not from the standard directory.

4. Create symbolic links in order to correctly load the files.

```
ln -s libpthread.so.Domino libpthread.so.0
ln -s librt.so.Domino librt.so.1
```

5. Return to the Domino data directory with **cd ..** or by using the full path.
6. Grant the **notes** user and group ownership. Our Linux user account for Domino is **itsodom6** and our group is **notes**, so we issue:

```
chown -R itsodom6:notes lib
```

in order to change the ownership of the **lib** directory and the files within it.

7. If you are not using the startup script described in “Starting Domino from a script” on page 130, then you will need to create a Domino 6 Server startup script to be launched by the Linux user account for Domino. Before the Domino 6 Server is started, we need to preload the new libraries and then load the Domino server. Make certain that your script includes the following lines emphasized in this sample script.

```
LD_PRELOAD_SAV=$LD_PRELOAD
LD_PRELOAD=$HOME/lib/libpthread.so.0:$HOME/lib/librt.so.1:$LD_PRELOAD
export LD_PRELOAD
```

```

nohup /opt/lotus/bin/server -jc -c > /dev/null 2>&1 &
sleep 3
LD_PRELOAD=$LD_PRELOAD_SAV
export LD_PRELOAD

```

This script takes the current system variable LD\_PRELOAD and saves it in a new variable LD\_PRELOAD\_SAV. It then sets the system variable LD\_PRELOAD to \$HOME/lib/libpthread.so.0:\$HOME/lib/librt.so.1: plus the value of the original LD\_PRELOAD; the **export** command makes the LD\_PRELOAD available to the whole system. The **nohup** command starts the Lotus Domino server and sends all the output to null (null is used to stop messages from being displayed to the screen); the **sleep** command tells the system to wait for 3 seconds before handing back control to the system. The last two commands set the LD\_PRELOAD back to its original setting.

8. Change to the Domino user account and execute the startup script. You can then verify that the new files are in use by checking the libraries used by the server process.
  - a. Issue **ps -A | grep server | more** to find the process ID of one of the server processes. The process ID is the number in the first column.
 

```
3333 ?          00:00:01 server
```
  - b. Type **more /proc/3333/maps** but replace 3333 with the process ID of the server process running on your machine. The output of the maps file should contain a reference to the new .Domino libraries.

```

40018000-40027000 r-xp 00000000 08:21 1357219
/local/notesdata/lib/libpthread.so.Domino
40027000-4004b000 rw-p 0000e000 08:21 1357219
/local/notesdata/lib/libpthread.so.Domino
4004b000-40051000 r-xp 00000000 08:21 1357220
/local/notesdata/lib/librt.so.Domino
40051000-40052000 rw-p 00005000 08:21 1357220
/local/notesdata/lib/librt.so.Domino

```

## SuSE 8.0 - glibc-2.2.5-38

With the existing Domino architecture on Linux, in order to truly scale SuSE Linux to thousands of concurrent users, we need to alter and recompile the linuxthreads portion of glibc on this version of SuSE. This section describes the steps to alter the pthread limit for SuSE 8.0 Professional; you will need to be root in order to carry out these steps. Unlike Domino R5 for Linux, Domino 6 takes advantage of the variable stack size provided by glibc, so you do not need to alter the stack size of glibc. Though there are quite a few steps, we have detailed them carefully so that even those relatively new to Linux should be able to make this alteration.

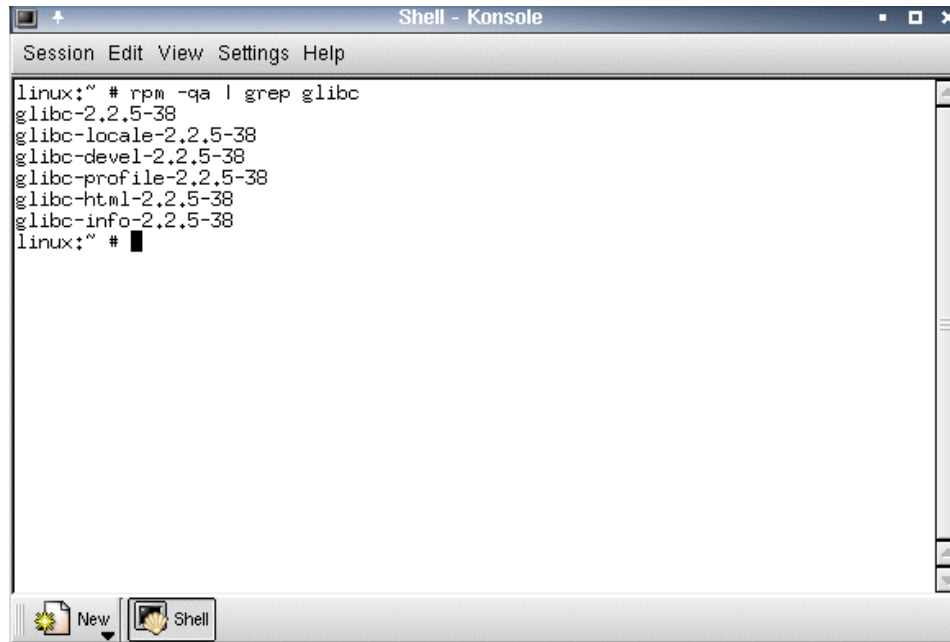
**Note:** We recommend using SuSE Linux Groupware Server 7 with Lotus Domino or newer, instead of the SuSE Linux 8.0 Personal or SuSE Linux 8.0 Professional version. The SuSE Enterprise Server already has the glibc changes detailed here.

### ***Install the glibc-2.2.5 source files***

1. Check for the version of glibc on your Linux system by issuing the command:

```
rpm -qa | grep glibc
```

This queries all packages and sends the output to the **grep** program, which searches for the value specified, in this case glibc. You should see output similar to that shown at the top of Figure 4-19.



```
linux:~ # rpm -qa | grep glibc
glibc-2.2.5-38
glibc-locale-2.2.5-38
glibc-devel-2.2.5-38
glibc-profile-2.2.5-38
glibc-headers-2.2.5-38
glibc-info-2.2.5-38
linux:~ #
```

*Figure 4-19 RPM Query Output, for SuSE 8.0*

2. While glibc is installed with Linux, the source code is not installed by default. Therefore, we need to install the source files so that we can adjust the definitions. You can install the source files from the sixth SuSE 8.0 CD or else download the appropriate glibc source code from the Internet. The source code you download should match the installed version, which is 2.2.5-38 for the standard SuSE 8.0 distribution.

**Attention:** If you do not use the version of source from the same origination as your original glibc, then you may miss any patches which the vendor has made, and therefore you run the risk of destabilizing your system.

3. To install the files, follow these steps:
  - a. Click the **CD-ROM** icon on the KDE desktop. This mounts the CD-ROM and displays the contents with the KDE file explorer, Konqueror.
  - b. Click **suse**, then click **zq2** to display the rpm source packages as shown in Figure 4-20.

**Note:** If you have installed from the DVD, all the source files are in **zq1**.

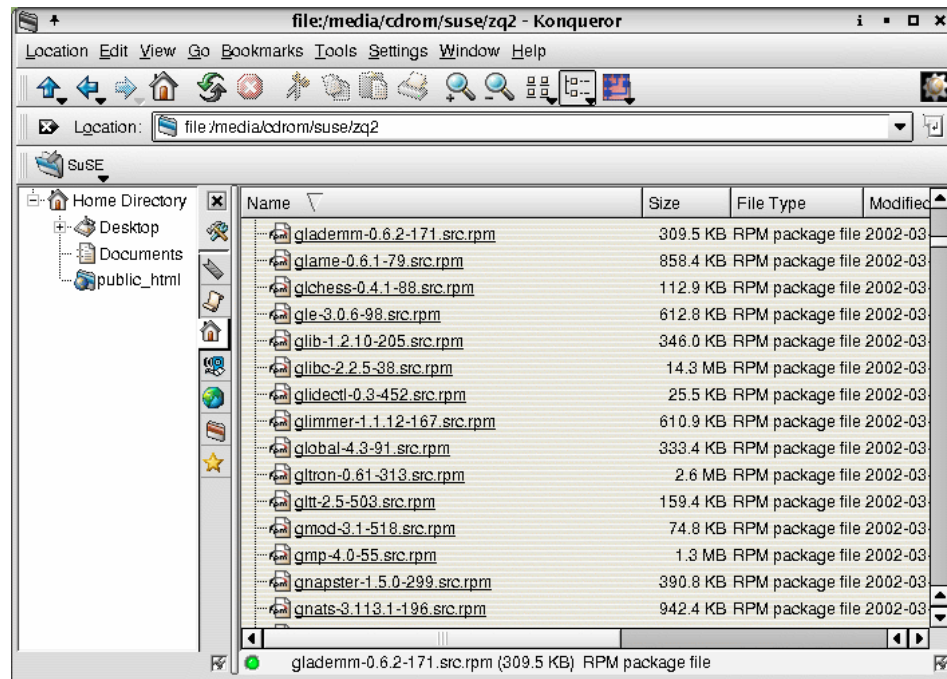


Figure 4-20 SuSE 8.0 list of source packages

- c. Scroll until you see **glibc-2.2.5-38.src.rpm**, click it to launch KPackage.
- d. Click the **Install** button to install the source package as shown in Figure 4-21.

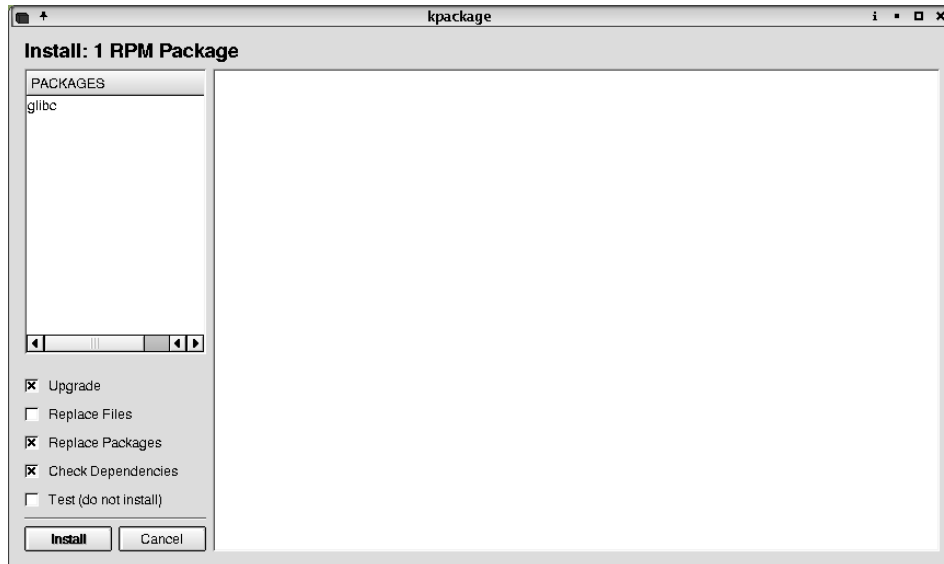


Figure 4-21 KPackage program for RPM package installation

If you are upgrading a different version of glibc, then make certain to replace 2.2.5-38 with the correct version number.

4. Start a shell and change directories with:

```
cd /usr/src/packages/SOURCES/
```

You should now see the file glibc-linuxthreads-2.2.5.tar.bz2 located in this directory. Since the file ends with .bz2, it has been compressed with bzip2 and can be decompressed with:

```
bunzip2 glibc-linuxthreads-2.2.5.tar.bz2
```

**Tip:** Linuxthreads is an add-on to glibc in the SuSE distribution and has been stored separately in this RPM. Therefore, we can modify just the linuxthread file and leave the main glibc file alone.

5. After decompressing the file, you need to unpack it. You can do this with the tar command:

```
tar -xvf glibc-linuxthreads-2.2.5.tar
```

### **Change one glibc-2.2.5 header file**

1. The **tar** command creates a new directory, *linuxthreads*, in the *SOURCES* directory. We need to edit one file in this directory, and since we are running X-Windows and using KDE on SuSE 8.0, we are going to use the Kate editor.

- a. Click **Start Application -> Office -> Editors -> Kate**.
- b. Click **File -> Open**.
- c. Starting with the / directory (and not the root home directory, which is /root) click **usr**, **src**, **packages**, **SOURCES**, **linuxthreads**, **sysdeps**, **unix**, **sysv**, **linux**, and **bits**. There are only a few files in this directory.
- d. Click **local\_lim.h** and click **OK** to open the file, as shown in Figure 4-22.

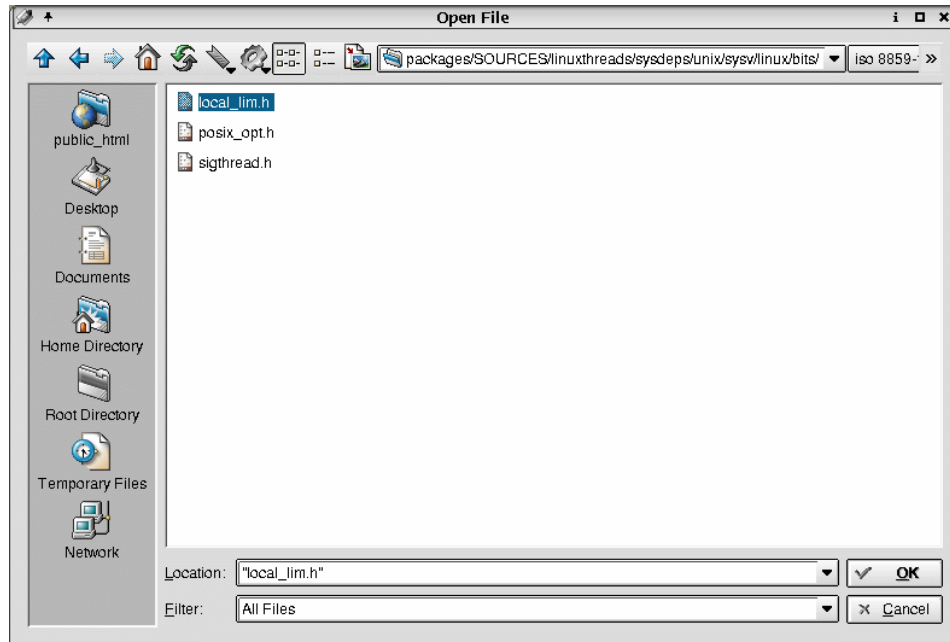


Figure 4-22 Kate Open file dialog box for *local\_lim.h*

2. With the file open, locate the appropriate **PTHREAD\_THREADS** line shown in Figure 4-16 on page 215. The steps are
  - a. Click **Edit - Find**.
  - b. Enter *PTHREAD\_THREADS* for the text to find.
  - c. Check the **Case Sensitive** option.
  - d. Click **OK**.

```
/* This is the value this implementation supports. */
/* #define PTHREAD_THREADS_MAX 1024 */
#define PTHREAD_THREADS_MAX 8192
```

Figure 4-23 Change to *local\_lim.h* for SuSE 8.0

3. Comment out the line:

```
#define PTHREAD_THREADS_MAX 1024
```



by adding the C-style programming, multi-line comment characters so it looks like this:

```
/* #define PTHREAD_THREADS_MAX 1024 */
```

4. Below the line you just commented out, enter:

```
#define PTHREAD_THREADS_MAX 8192
```

This will increase the per process Posix thread limit from 1024 to 8192.

5. Save and close the file.

### ***Build glibc-2.2.5 with the changes***

1. Now that you have edited the file, you need to replace the existing tar file with the new version that includes your adjustments.
  - a. Return to the SOURCES directory with `cd /usr/src/packages/SOURCES`.
  - b. Enter `rm -f glibc-linuxthreads-2.2.5.tar` to delete the file. The `-f` switch merely suppresses the text prompt to confirm deletion - you can use the command without `-f` if you prefer to be prompted.
  - c. Enter `tar -cvf glibc-linuxthreads-2.2.5.tar linuxthreads linuxthreads_db` to pack the files located in the two specified directories.

**Note:** This command should be typed on one line, as shown in Figure 4-24

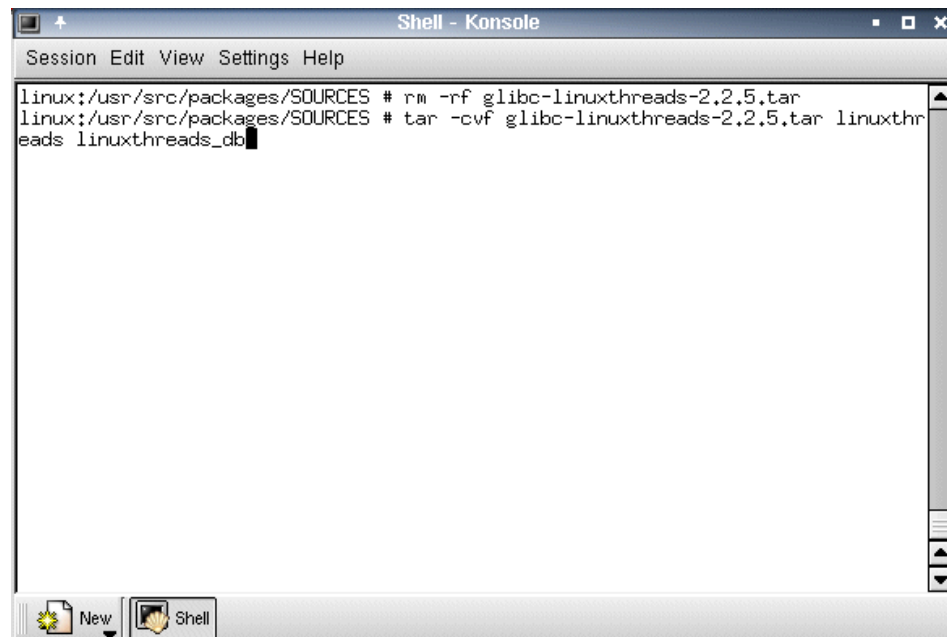
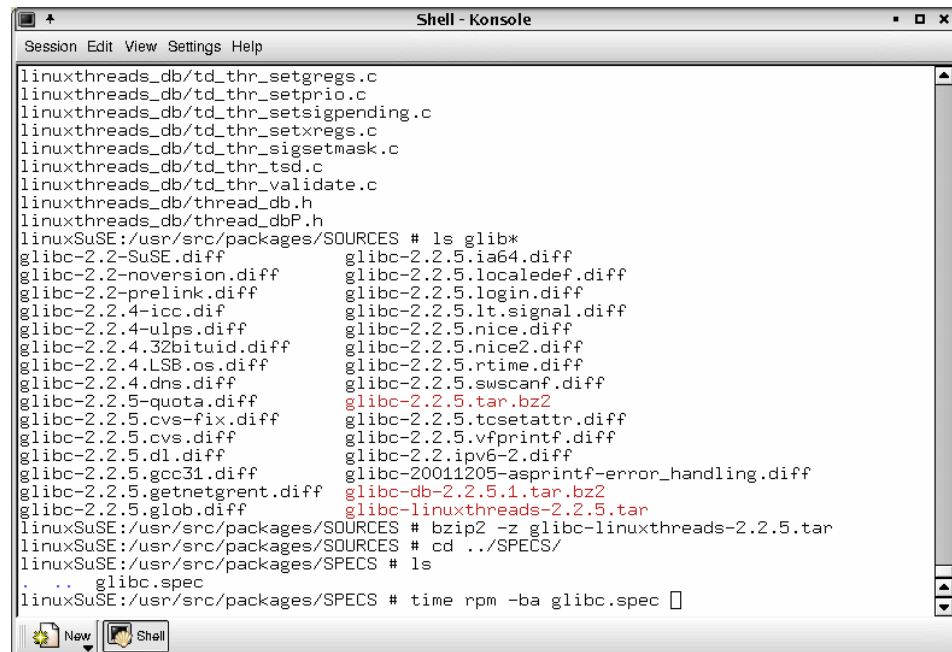


Figure 4-24 `tar` command for `glibc-linuxthreads`

- d. Enter **bzip2 -z glibc-linuxthreads-2.2.5.tar** to compress the tar file.
2. Change to the SPECS directory with **cd ../SPECS** or by specifying the full path of **/usr/src/packages/SPECS**. To build the new linuxthread files you need, enter the following command:

```
rpm -ba glibc.spec
```

**Tip:** This took approximately one hour on the test servers in our lab. You can preface the command with **time** to measure how long it takes.



```

linuxthreads_db/td_thr_setgregs.c
linuxthreads_db/td_thr_setprio.c
linuxthreads_db/td_thr_setsigpending.c
linuxthreads_db/td_thr_setxregs.c
linuxthreads_db/td_thr_sigsetmask.c
linuxthreads_db/td_thr_tsd.c
linuxthreads_db/td_thr_validate.c
linuxthreads_db/thread_db.h
linuxthreads_db/thread_dbP.h
linuxSuSE:/usr/src/packages/SOURCES # ls glib*
glibc-2.2-SuSE.diff          glibc-2.2.5.ia64.diff
glibc-2.2-noversion.diff    glibc-2.2.5.localedef.diff
glibc-2.2-prelink.diff      glibc-2.2.5.login.diff
glibc-2.2.4-icc.diff        glibc-2.2.5.lt.signal.diff
glibc-2.2.4-ulps.diff       glibc-2.2.5.nice.diff
glibc-2.2.4.32bituid.diff   glibc-2.2.5.nice2.diff
glibc-2.2.4.LSB.os.diff     glibc-2.2.5.rtime.diff
glibc-2.2.4.dns.diff        glibc-2.2.5.swscanf.diff
glibc-2.2.5-quota.diff      glibc-2.2.5.tar.bz2
glibc-2.2.5.cvs-fix.diff    glibc-2.2.5.tcsetattr.diff
glibc-2.2.5.cvs.diff        glibc-2.2.5.vfprintf.diff
glibc-2.2.5.dl.diff         glibc-2.2.ipv6-2.diff
glibc-2.2.5.gcc31.diff      glibc-20011205-asprintf-error_handling.diff
glibc-2.2.5.getnetgrent.diff glibc-db-2.2.5.1.tar.bz2
glibc-2.2.5.glob.diff       glibc-linuxthreads-2.2.5.tar
linuxSuSE:/usr/src/packages/SOURCES # bzip2 -z glibc-linuxthreads-2.2.5.tar
linuxSuSE:/usr/src/packages/SOURCES # cd ../SPECS/
linuxSuSE:/usr/src/packages/SPECS # ls
.  .. glibc.spec
linuxSuSE:/usr/src/packages/SPECS # time rpm -ba glibc.spec

```

Figure 4-25 Building glibc-2.2.5

3. The two new share object files (the Linux equivalent to Windows dll files) will be located in the **/usr/src/packages/BUILD/glibc-2.2.5** directory in the following sub-directories:

```
cc/linuxthreads/libpthread.so
```

```
cc/rt/librt.so
```

### Load the new thread library

1. Change to your Domino data directory. The default is **cd /local/notesdata**.
2. Issue the command **mkdir lib** to create a directory for the new files and **cd lib** to change to the newly created directory.

3. Copy the new libpthread.so and librt.so from the BUILD directory.

```
cp /usr/src/packages/BUILD/glibc-2.2.5/cc/linuxthreads/libpthread.so
./libpthread.so.Domino

cp /usr/src/packages/BUILD/glibc-2.2.5/cc/rt/librt.so ./librt.so.Domino
```

**Important:** After building glibc-2.2.5, you now have two versions of libpthread.so and librt.so. Make certain you copy the files from the /usr/src/packages/BUILD directory and not from the standard directory.

4. Create symbolic links i to correctly load the files:

```
ln -s libpthread.so.Domino libpthread.so.0
ln -s librt.so.Domino librt.so.1
```

5. Return to the Domino data directory with **cd ..** or by using the full path.

6. Grant the notes user and group ownership. Our Linux user account for Domino is *itsodom6* and our group is *notes*, so we issue:

```
chown -R itsodom6:notes lib
```

to change the ownership of the lib directory and the files within it.

7. If you are not using the startup script described in “Starting Domino from a script” on page 130, then you will need to create a Domino 6 Server startup script to be launched by the Linux user account for Domino. Before the Domino 6 Server is started, we need to preload the new libraries and then start the Domino server. Make certain that your script includes the following lines emphasized in this sample script.

```
LD_PRELOAD_SAV=$LD_PRELOAD
LD_PRELOAD=$HOME/lib/libpthread.so.0:$HOME/lib/librt.so.1:$LD_PRELOAD
export LD_PRELOAD
nohup /opt/lotus/bin/server -jc -c > /dev/null 2>&1 &
sleep 3
LD_PRELOAD=$LD_PRELOAD_SAV
export LD_PRELOAD
```

This script take the current system variable LD\_PRELOAD and saves it in a new variable LD\_PRELOAD\_SAV. It then sets the system variable LD\_PRELOAD and to \$HOME/lib/libpthread.so.0:\$HOME/lib/librt.so.1: plus the value of the original LD\_PRELOAD; the **export** command makes the LD\_PRELOAD available to the whole system. The **nohup** command starts the Lotus Domino server and sends all the output to null (null is used to stop messages displaying to the screen); the **sleep** command tells the system to wait for 3 seconds before handing back control to the system. The last two commands set the LD\_PRELOAD back to its original setting.

8. Change to the Domino user account and execute the startup script. You can then verify that the new files are in use by checking the libraries used by the server process.

- a. Issue `ps -A | grep server | more` to find the process ID of one of the server processes. The process ID is the number in the first column.  
3333 ? 00:00:01 server
- b. Type `more /proc/3333/maps` but replace 3333 with the process ID of the server process running on your machine. The output of the maps file should contain a reference to the new .Domino libraries.

```
40018000-40027000 r-xp 00000000 08:21 1357219
/local/notesdata/lib/libpthread.so.Domino
40027000-4004b000 rw-p 0000e000 08:21 1357219
/local/notesdata/lib/libpthread.so.Domino
4004b000-40051000 r-xp 00000000 08:21 1357220
/local/notesdata/lib/librt.so.Domino
40051000-40052000 rw-p 00005000 08:21 1357220
/local/notesdata/lib/librt.so.Domino
```

## 4.2 Domino performance and scalability

This section describes some of the general features and functions related to Domino server performance, scalability, and reliability.

### 4.2.1 Domino performance

Domino Enterprise Server offers clustering, which provides superior performance by increasing the availability of your databases and answering client requests in the best fashion determined by dynamic analysis of the cluster members' current performance. Transaction logging is available with every installation of Domino; it improves long-term reliability by keeping data from being deleted during consistency checks caused by the failure of a server. In addition, multiple mailboxes are a simple change that will help with mail delivery performance.

#### Clustering

As the Beowulf Project amply demonstrates (<http://www.beowulf.org>), Linux is well-suited to clustering, and this is true of Linux Domino 6 clustering as well. The benefits of Domino clusters are primarily due to two factors:

- ▶ Availability
- ▶ Workload balancing

In essence, Domino clusters appear to Notes clients as a single server. When a server fails, the other server or servers in the cluster handle client requests

seamlessly. When a server in the cluster is overburdened, workload balancing shunts the request to another cluster member, thereby providing better service.

There are secondary benefits as well, though these indirect benefits were not specifically designed as part of clustering. Should one database become corrupt, it is possible to delete that replica and create a new one from a replica located on another cluster member. This would be a risky proposition with a replica on a standard replication schedule since it could be out-of-date and so result in data loss. Domino clusters, on the other hand, are kept up-to-date through event-driven replication provided by the Cluster Replicator task. Differences are measured in seconds, instead of hours or days.

**Note:** Domino 6 provided clustering for Web clients via ICM (Internet Cluster Manager) For more information see *Applying the Patterns for e-business to Domino and WebSphere Scenarios*, SG24-6255. For business-critical applications you should investigate the use of specialized load balancing equipment like IBM WebSphere Edge Server or Cisco LocalDirector.

Once you have the Enterprise edition of Domino installed, you can add servers to a cluster by clicking the **Add to Cluster** button in the Domino Directory. Some points to keep in mind when you set up a Domino cluster:

- ▶ Use all servers in the cluster instead of designating a standby server. This will provide better service to your customers and will utilize your resources more effectively. Keep in mind, however, that you should not allow the average usage (number of client requests, databases, and so forth) to exceed the capabilities of the cluster minus one server.
- ▶ You should use two cluster replicators to prevent backlogs. In your notes.ini, add the line `cluster_replicators=2`. When an agent begins updating a large number of documents in a database, this will require the cluster replicator to work almost exclusively on that database. A second replicator will allow quick updates in other databases to be replicated immediately. Do not enable more than two cluster replicators until statistical analysis indicates that you would benefit from additional replicators. You can measure the load on your cluster replicators by issuing **show stat** combined with one of these four statistics at the Domino console:
  - `Replica.Cluster.SecondsOnQueue.Avg` shows the average amount of time a database spent replicating.
  - `Replica.Cluster.SecondsOnQueue.Max` shows the maximum amount of time a database spent replicating.
  - `Replica.Cluster.WorkQueueDepth.Avg` shows the average number of databases waiting to be replicated.

- `Replica.Cluster.WorkQueueDepth.Max` shows the maximum number of databases waiting to be replicated.

The `SecondsOnQueue.Avg` will tell you how long it is taking to replicate data. A private LAN will likely reduce this number. The `SecondsOnQueue.Max` will tell you the longest amount of time a single database tied up the cluster replicator. If this number is high, it indicates that you have at least one database that demands intense cluster replication.

The `WorkQueueDepth.Avg` is probably the best indicator of whether multiple replicators will be of any benefit. If this number is 0, databases are not normally vying for the cluster replicator's attention. The statistic `WorkQueueDepth.Max` indicates the worst backlog the server has experienced. If both this and the `SecondsOnQueue.Max` are high, then you have at least one database tying up a replicator and causing a backlog. However, if the `SecondsOnQueue.Avg` is low, then it indicates a temporary burst that is probably not a major problem.

You need to consider all four statistics in context before determining if additional cluster replicators will be of use. In any event, make certain your server can handle the additional load before you enable 3 or more cluster replicators.

- Set up a private LAN for intra-cluster communication. With two servers, you can use a simple cross-over cable to connect the servers. With three or more, you need to set up a small network. The extra effort is well worth it because you remove the network load for clustering from the main LAN used by clients, and at the same time ensure that client traffic will not interfere with the high-speed cluster replication necessary for transparent failover.

**Important:** Cluster replication is the single most important aspect of a Domino cluster. You should monitor cluster replication closely to ensure the health of your Domino 6 cluster.

- With clusters of three or more servers, take the time to consider a strategy for deploying replicas. The simplest approach is to deploy replicas on every server. But if you have a three server cluster, can a single server handle the full load if two servers fail? It is unlikely if you are utilizing your resources and so having a replica of every database does not provide added reliability. On the other hand, if two servers in a three server cluster are busy, then having a replica on the third server will allow workload balancing. This suggests that you should normally distribute databases on two out of three servers, with only critical applications replicated to all three servers. The same logic can be extended to four or more servers.
- Distribute databases according to measured, or expected, utilization. For instance, if you have a 3 server cluster and decide all databases with a

filename beginning with a-p will be placed on the Artemis server, i-z on Odin, and the rest on the last server, you will have devised an orderly administrative scheme. If the company's major databases all end up on the Artemis server, however, you will cause needless workload balancing, and should that server fail, the bulk of your users will be switched to a single server instead of being distributed across the remaining two. Conversely, if you are constantly analyzing every database, you will waste precious administrative time placing and shifting databases among cluster members. Since critical databases should probably go on every server in the cluster, focus on identifying the major databases and use an easily administered scheme for the rest.

## Transaction logging

The main benefit of transaction logging is reliability. Any administrator who has waited a long time for a system that crashed to restart will immediately appreciate transaction logging. Just as journaling improves the integrity of the Linux ext3 file system, Domino transaction logging improves the integrity of Domino databases.

Transaction logging comes in three flavors: archive, circular, and linear. Archive is intended for coupling your transaction logs with a Domino-aware backup system, while circular and linear are for non-Domino-aware backup system use. (See "Domino 6 transaction logs and backups" on page 429.)

If you are not going to use your transaction logs in conjunction with a Domino-aware backup system, all you need is a pair of 4 Gb hard disk drives configured for RAID1. You need to dedicate these drives to the Domino Transaction Log to avoid a performance degradation.

**Note:** The maximum size for circular transaction logging is 4Gb. It can be set to less. The linear option has been added to Domino 6 in case you would like to utilize more than 4 GB for your transaction logs. Otherwise, it is comparable to the circular option.

Ideally, everything, from the OS to Swap to Domino, would have its own hard disk drives utilizing multiple RAID controllers, but this is an unlikely scenario for all but very high-end servers. When possible, use hardware-based RAID1 for the OS and Swap, another RAID1 for the transaction logs, and RAID5 for the Domino data directory.

Given the advantages of transaction logs in achieving data integrity and the substantially faster restarts of your server, we recommend enabling transaction logging even if you only have a single, hardware-based RAID1 for OS, Swap, and the transaction logs, and a RAID5 for the data directory. This is admittedly not an ideal scenario since the Swap and transaction logs will be competing for

I/O resources. Unlike NT, however, Linux does not rely as heavily on Swap. As long as your server has enough memory, this should be a suitable configuration. Be certain to test this scenario, however, in order to make certain that you are content with the resulting performance.

How about using a RAID5 configuration for the entire server? While RAID5 is an appealing option for getting the most out of your hard disk drives, it is not suitable for the entire server, especially with transaction logging enabled. Remember that when writing to disk, RAID5 will need to read data from the disk in order to recalculate the parity, except when performing a *full-stripe-write* in which the data is already in the cache. The additional I/O overhead from *partial-stripe-write* and *read-modify-write* operations results in RAID5 exhibiting slower write performance than RAID1. Read performance is typically slower as well since RAID1 offers two drives from which data may be read. Though RAID5 offers more drives for simultaneous reads, the requests would have to be ideally broken up so that no two requests ever needed information on the same drive. This is because in RAID5 the data is not mirrored – redundancy is provided by the parity stripe – and so there is only one location from which data can be read. RAID5, preferably through hardware not software, should be utilized only for the Domino data directory. If you have to use RAID5 for the entire server, you should not enable transaction logging.

**Note:** Transaction logging is set up via the Task tab on the server document; see the Lotus Administrator Guide for more information.

## Multiple mailboxes

Since server processes require exclusive access to *mail.box*, it is possible for several servers to contend for the mail.box, especially while the router task is working on a large message. Therefore, you should set the number of mailboxes equal to *two* in the default configuration document for your domain.

1. Open the Domino Directory.
2. Go to **Server -> Configuration**.
3. Open the appropriate Configuration document: \* - **[All Servers]**
4. Go to the **Router/SMTP -> Basics** tab.
5. Edit the document and set the number of mailboxes to **2**.

You can set the number higher than two, but you should do so only after you determine that there is still contention with two mail.boxes. Refer to the Lotus Domino Administrator 6 Help for more information.



**Note:** If you have older, 3rd-party software that is unable to work with two mail.boxes, create a configuration document for the server on which the software is running until you can upgrade it.

## 4.2.2 Domino scalability

Domino 6 has been designed, like its predecessors, to run on a variety of platforms and to take full advantage of any platform's capabilities. The Domino 6 Linux code has been specifically written to run well on Linux.

So what can you do to increase Domino 6 scalability?

Simple. Domino 6 is capable of providing a large number of services, everything from mail routing to applications to Web sites. In order to allow your server to scale, identify all unnecessary tasks and remove them.

The first place to start is the `servertasks=` line in the `notes.ini`. You can access the file directly at the OS level or by the **NOTES.INI file** option on the **Configuration** tab under **Server** in the `webadmin.nsf` database.

The basic tasks are Replica, Router, Update, Stats, AMgr, and Adminp. Other tasks, such as HTTP, should only be enabled if you intend to utilize them. For example, if your server does not need to provide Calendaring and Scheduling, you can remove Calconn and Sched from the `servertasks=` line.

### Network encryption and compression

Network encryption is another area to consider. Domino offers port encryption to ensure that all data is securely transferred over the network, and it is enabled simply by checking the encrypt option for the port. However, encryption necessarily causes overhead and so results in slower performance. Typically, the security of port encryption results in a performance trade-off of roughly 5 to 10 percent, as long as overall CPU utilization is not excessively high.

Network compression compresses the data before it is transmitted across the network. Network compression results in an average of 50 percent less volume of data being transmitted across the network, but it does put extra load on the client and server to uncompress/compress the data. The best time to use compression is when data is being transmitted across a Wide Area Network (WAN).

**Important:** Encryption and compression can be used together: first the data is compressed and then it is encrypted. Using both options together puts even more load on the CPUs at both ends of the connection.

## NSF Buffer Pool size

Domino normally manages the NSF Buffer Pool and sets the value to approximately 1/4 to 1/3 of the available physical memory. On servers with more than 2 GB of memory, this can squeeze the mmap region where the memory is allocated. Therefore, a Domino 6 server running on Linux should not have an `NSF_Buffer_Pool_Size_MB` notes.ini setting of greater than 256. This setting does have a noticeable effect on opening large views, however, so you should not set it too low. Add the line `NSF_Buffer_Pool_Size_MB=` to your notes.ini with a value of 256 MB or 1/4 of your physical memory, whichever is lower.

## 4.3 Troubleshooting

This section covers basic network troubleshooting and the Notes Diagnostic tool, NSD.

### 4.3.1 Basic network troubleshooting

Linux network troubleshooting is very similar to Windows troubleshooting. The main differences are the name of the trace route tool – in Linux it is **tracertoute** and the Windows version is **tracert** – and the syntax of the **route** command.

The first things to check if you are unable to access the server are:

- ▶ Can you ping the server/client by name?
- ▶ Can you ping the server/client by IP address?
- ▶ Can you ping the default gateway from both a client and the server?

If you can ping the server/client by IP address but not by name there is a problem with your name resolution. Linux does not support WINS so you have to use DNS or host files.

If you can't ping the server/client, can they ping any other network devices like the default gateway. If they are unable to ping anything ask the network administrator to check the network devices.

If some clients can ping the server but others can't, check the netmask of the clients/server with the **ifconfig** command on Linux or with **ipconfig** or **winiipcfg** on Windows machines. To make sure that all the machines have the correct default gateway use **route -v** on Linux or **route print** on Windows machines (see Figure 4-26).

**Note:** If there is a firewall between your server and client, the ping and traceroute commands may be blocked, which makes troubleshooting harder.

**Windows Command Prompt Output:**

```

C:\WINDOWS\System32\cmd.exe
Active Routes:
Network Destination    Netmask          Gateway          Interface        Metric
0.0.0.0                0.0.0.0          9.33.85.65       9.33.85.88       20
9.33.85.64             255.255.255.192  9.33.85.88       9.33.85.88       20
9.33.85.88             255.255.255.255  127.0.0.1        127.0.0.1        20
9.255.255.255         255.255.255.255  9.33.85.88       9.33.85.88       20
127.0.0.0              255.0.0.0        127.0.0.1        127.0.0.1        1
192.168.0.0            255.255.255.0    192.168.0.20     192.168.0.20     30
192.168.0.20          255.255.255.255  127.0.0.1        127.0.0.1        30
192.168.0.255         255.255.255.255  192.168.0.20     192.168.0.20     30
192.168.139.0         255.255.255.0    192.168.139.1    192.168.139.1    30
192.168.139.1         255.255.255.255  127.0.0.1        127.0.0.1        30
192.168.139.255       255.255.255.255  192.168.139.1    192.168.139.1    30
224.0.0.0              240.0.0.0        9.33.85.88       9.33.85.88       20
224.0.0.0              240.0.0.0        192.168.0.20     192.168.0.20     30
224.0.0.0              240.0.0.0        192.168.139.1    192.168.139.1    30
255.255.255.255       255.255.255.255  9.33.85.88       9.33.85.88       1
255.255.255.255       255.255.255.255  192.168.0.20     192.168.0.20     1
255.255.255.255       255.255.255.255  192.168.139.1    192.168.139.1    1
Default Gateway:      9.33.85.65
=====
Persistent Routes:
None
E:\jonnieb>route print
  
```

**Linux Shell Output:**

```

Shell - Konsole <2>
Session Edit View Settings Help
linux:/jonnieb # route -v
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
192.168.0.0 * 255.255.255.0 U 0 0 0 eth0
192.168.137.0 * 255.255.255.0 U 0 0 0 eth1
default 192.168.0.1 0.0.0.0 UG 0 0 0 eth0
linux:/jonnieb # route -v
  
```

Figure 4-26 Default gateway commands

## 4.3.2 Domino NSD tool

Notes System Diagnostic (NSD) is a diagnostic script, developed by Iris, that gathers diagnostic information which can be used to troubleshoot problems and verify that the server is correctly configured.

### Running NSD

You must be in the Domino data directory to run NSD. You can run the NSD tools as either the notes account or as root. For most problems you should run NSD as the notes account.

### ***Options for NSD***

There are a number of options that can be used with the NSD tool depending on the level of detail required. Following is a summary of the options.

The NSD tool is constantly evolving and changing, and new options may be added in the future. The **-help** option will show a complete list for the version of NSD you have installed.

<b>-batch</b>	Run in batch mode - don't write to tty
<b>-info</b>	Just report system info
<b>-noinfo</b>	Don't report system info
<b>-nolog</b>	Don't log output to log file
<b>--nodbx</b>	Don't collect process debug info
<b>-ver*sion</b>	Just show version header
<b>-ps</b>	Show process tree
<b>-kill</b>	Kill all/user Notes processes and cleanup IPCs
<b>-memcheck</b>	Run the Notes memory checker only
<b>-nomemcheck</b>	Don't run the Notes memory checker by default
<b>-dumpmem</b>	Generate shared memory dump
<b>-lsof</b>	Run lsof only - list Notes open files
<b>-nolsof</b>	Don't run lsof by default
<b>-user &lt;user_id&gt;</b>	Operate only on Notes process run by 'user_id'
<b>-exec_path &lt;dir[:dir]*</b>	Add additional directories to the search path
<b>-filter &lt;log_file&gt;</b>	Filter stack output of log_file
<b>-help</b>	Show this help list
<b>-help -&lt;option&gt;</b>	Where option is any one of the above
<b>-help gen*eral</b>	General information about the script and how it works
<b>-help lim*itations</b>	General information on script limitations
<b>-help update</b>	List script version update information

The most notable options are:

- kill**
- info**
- nomemcheck**

Issuing **nsd -kill** will kill all Notes processes and clean up IPC resources related to those processes.

Any time the server is not able to be shut down with a graceful quit from the console or a **server -q** from the command line, **nsd -kill** should be run to ensure that the environment is clean for a server restart.

The command **nsd -info** will skip attaching to the processes with a debugger and obtaining a trace. This is useful when you are only gathering system information and do not need any process-level information for diagnosis.

Lotus Support will often ask for the results from running **nsd -info** so they can do an initial assessment of the server environment.

Issuing **nsd -nomemcheck** will skip running memcheck against the application. Memcheck is a utility, developed by Iris, that obtains information on the current state of the Domino memory pools. Memcheck information may not be needed, and by using the **-nomemcheck** option you can reduce the total running time of the NSD script.

The output of the NSD tool can be sent to Lotus Support to help diagnose problems.

### ***NSD explained***

The NSD tool is constantly evolving. Additional data may be gathered and placement of the NSD sections may be altered, but the information is roughly the same across different versions of NSD.

NSD output is in plain text and can be viewed with any text file viewer.

The first section (shown in Example Figure 4-3) contains a header with some basic information about the configuration of the machine

#### ***Example 4-3 NSD Output***

---

```
INFO: Generating binary list file ./nsd.nadmb2/nsd_V60_09082002_cache.ins.lst
INFO: Generating cache file ./nsd.nadmb2/nsd_V60_09082002_cache.ins
Invalid PID 0
Script Version      : /opt/lotus/notes/latest/linux/nsd.sh V60_09082002
Notes Version       : Build V60_09082002 September 08, 2002
Notes Base          : Release 6
Data Dir            : /home/nadmb2/notesdata
Notes Exec Dir      : /opt/lotus/notes/latest/linux
Search Path         : /opt/lotus/notes/latest/linux /opt/lotus/notesapi
Debugger            : /opt/lotus/notes/latest/linux/pstack
Debugger Version    :
MEMCHECK Version    : MEMCHECK Version (4.20) for Lotus Notes Build V60_09082002 (September 08, 2002)
Script Dir          : /opt/lotus/notes/latest/linux
Host Info           : Linux branch 2.4.18-64GB-SMP #1 SMP Wed Mar 27 13:58:12 UTC 2002 i686 unknown
```

User : nadmb2 (nadmb2)  
Date : Thu Sep 12 15:18:57 EDT 2002  
Input arguments :

---

The next section of the NSD output is the current processes running on the system (ps output). This list is not only the processes owned by the notes user, but contains all processes.

#### Example 4-4 Current processes

---

Current Procs:

=====

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	STIME	TTY	TIME	CMD
004	S	root	1	0	0	80	0	-	112	do_sel	05:24	?	00:00:07	init [5]
002	S	root	2	1	0	80	0	-	0	contex	05:24	?	00:00:00	[keventd]
002	S	root	3	0	0	80	19	-	0	ksofti	05:24	?	00:00:00	[ksoftirqd_CPU0]
022	S	root	4	0	0	61	0	-	0	kswapd	05:24	?	00:00:00	[kswapd]
002	S	root	5	0	0	62	0	-	0	bdfus	05:24	?	00:00:00	[bdfus]
002	S	root	6	0	0	79	0	-	0	kupdat	05:24	?	00:00:08	[kupdated]
002	S	root	7	0	0	62	0	-	0	kinode	05:24	?	00:00:00	[kinode]
002	S	nadmban	2061	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2062	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2063	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2064	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2065	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2066	1994	0	80	0	-	59821	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2067	1994	0	80	0	-	59821	do_sel	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/http
002	S	nadmban	2068	1971	0	80	0	-	27677	semop	11:27	pts/3	00:00:00	/opt/lotus/notes/latest/linux/adminp
002	S	nadmban	2082	2070	0	80	0	-	50567	do_pol	11:27	pts/4	00:00:00	java_vm
002	S	nadmban	2083	2070	0	80	0	-	50567	rt_sig	11:27	pts/4	00:00:00	java_vm
002	S	nadmban	2084	2070	0	80	0	-	50567	nanosl	11:27	pts/4	00:00:00	java_vm
002	S	nadmban	2085	2070	0	80	0	-	50567	rt_sig	11:27	pts/4	00:00:00	java_vm
002	S	nadmban	2086	2070	0	80	0	-	50567	unix_s	11:27	pts/4	00:00:00	java_vm
002	S	nadmban	2100	2070	0	80	0	-	50567	rt_sig	11:28	pts/4	00:00:00	java_vm
002	S	nadmban	2109	1964	0	80	0	-	27276	semop	11:28	pts/3	00:00:00	/opt/lotus/notes/latest/linux/replica
002	S	nadmban	2114	1961	0	80	0	-	27384	semop	11:29	pts/3	00:00:00	/opt/lotus/notes/latest/linux/update
002	S	nadmban	2141	2005	0	80	0	-	11460	rt_sig	11:41	pts/4	00:00:00	/opt/mozilla/mozilla-bin

---

This is followed by the process tree. The process tree gives a listing of the Notes server processes and their parent/child relationship to each other.

In this example, the shell (bash) is listed as the parent for all processes, and the server is the parent of all Notes processes.

This can be useful, especially when there are orphaned Notes processes, as they will be represented with a return line between the other processes.

In the UNIX environment each process that is started has a parent process. In the case of a running Domino server, the parent of all the processes is the shell from which the server was started.

The first instance of the server process would be its child, and the server process would call other processes, such as event or update. These processes would be called the child processes of the server.

When one process exits, the child process for that process becomes “orphaned,” which means that the parent process has exited and the operating system reverts the parent to init, which is the first process started in a UNIX operating system. Init is responsible for loading all other processes and always has the process ID of 1.

This information can sometimes lead us to which process has crashed when a crash does occur and sufficient crash information is not captured (such as when the core file is truncated).

Example 4-5 is the process tree for a normally running server.

*Example 4-5 NSD process tree*

PROCESS TREE

Status is:

R

-- process is running

D

-- process is dead

T/status

-- process terminated with exit status

S/signal

-- process killed with signal

?

-- Unknown status

username	status	pid	program
root	R	1	0 init
nadmb2	R	... 1200	1097 su - nadmb2
nadmb2	R	.... 1201	1200 -bash
nadmb2	R	..... 2117	2046 /opt/lotus/notes/latest/linux/server
nadmb2	R	..... 2286	2127 /opt/lotus/notes/latest/linux/http
nadmb2	R	..... 2240	2127 /opt/lotus/notes/latest/linux/http
nadmb2	R	..... 2150	2127 /opt/lotus/notes/latest/linux/sched
nadmb2	R	..... 2149	2127 /opt/lotus/notes/latest/linux/calconn
nadmb2	R	..... 2142	2127 /opt/lotus/notes/latest/linux/adminp
nadmb2	R	..... 2141	2127 /opt/lotus/notes/latest/linux/amgr
nadmb2	R	..... 2173	2141 /opt/lotus/notes/latest/linux/amgr -e
nadmb2	R	..... 2140	2127 /opt/lotus/notes/latest/linux/router
nadmb2	R	..... 2135	2127 /opt/lotus/notes/latest/linux/replica
nadmb2	R	..... 2134	2127 /opt/lotus/notes/latest/linux/update
nadmb2	R	..... 2121	2117 /opt/lotus/notes/latest/linux/event

The R in the second column shows the process is active, running.

Example 4-6 on page 238 is another process tree, this time for a server where the server process has exited without a trace.

Notice that none of these processes are shown as a parent/child to each other with one exception. Amgr is shown as being a parent for another amgr process. This is because the server loads amgr and the initial amgr process, then loads subsequent amgr tasks. Each of the other processes was loaded as a child of the server process.

#### *Example 4-6 NSD child process*

---

```
nadmb2    R    .....  2286   2127 /opt/lotus/notes/latest/linux/http
nadmb2    R    .....  2240   2127 /opt/lotus/notes/latest/linux/http
nadmb2    R    .....  2150   2127 /opt/lotus/notes/latest/linux/sched
nadmb2    R    .....  2149   2127 /opt/lotus/notes/latest/linux/calconn
nadmb2    R    .....  2142   2127 /opt/lotus/notes/latest/linux/adminp
```

---

The next section contains the stack traces obtained from the debugger. These will probably not make much sense to anyone other than support and development specialists.

The one thing you can check for is that one of the threads contains the word “fatal” or “panic.”

If the problem is a server crash and there is not a thread listed with either of those keywords, then it is likely that there was a problem during data collection and the crash information was not collected in time.

**Note:** There are exceptions to that rule, so always forward all available data to support, even if it appears to be of limited value.

For example, the following stack (Example 4-7) shows a fatal error on HTTP.

#### *Example 4-7 HTTP fatal error*

---

```
#####
## thread 19/100 :: http pid=12634, k-id= 23495 , pthr-id=537117116
## stack      :: k-state=running, stk max-size=331772, cur-size=116812
#####
fatal_error(?) at 0xd10e7ac8
pthread_kill(?, ?) at 0xd0e7ad14
signal.raise(?) at 0xd0e7a94c
abort.abort() at 0xd0d79ca0
terminate.terminate__Fv() at 0xd0e8f2e0
invokedtr.__Invoke__Destructor(0x2000ea8c, 0x209501fc) at 0x1000cb58
```

---



**Note:** You should always see a fatal\_error() call on the stack trace of the failing thread. This is the function that prints out the “Freezing all server threads...” message.

The next section contains Inter Process Communication Facilities Status (IPCS) information. IPCS details the shared memory, message queues and semaphore information for the machine.

Shared memory has one control segment and several data segments. The data segments will be of uniform size, while the control segment is usually smaller than the data segments.

There is no need to manually remove these files on a successful shutdown of the server. If the server crashes, an nsd -kill will clean these files up.

You can also manually check for the existence of these files by issuing the command at the OS:

**ipcs**

**Note:** Each partitioned server will have its own set of shared memory. The owner of these files will be the user starting the different partitioned servers.

Example 4-8 shows a sample view of shared memory.

*Example 4-8 Viewing shared memory*

IPC STATS							Thu Sep 12 15:19:15 EDT 2002
T	shmid	key	owner	perms	bytes	nattch	status
m	27459594	0xf8c03000	nadmb2	660	4629980	12	
m	27492363	0xf8c03001	nadmb2	660	8388608	12	
m	27820071	0xf8c0300b	nadmb2	660	8388608	12	
m	27852840	0xf8c0300c	nadmb2	660	8388608	12	
m	27885609	0xf8c0300d	nadmb2	660	8388608	12	
m	27918378	0xf8c0300e	nadmb2	660	8388608	12	
m	27951147	0xf8c0300f	nadmb2	660	8388608	12	

The next two sections, shown in Example 4-9, are the Notes.ini followed by the Notes user’s environment. If you have run the NSD as root then it will instead reflect the root user’s environment.

*Example 4-9 Notes.ini and info about Notes user’s environment*

notes.ini		Wed Jul 10 11:42:38 EDT 2002
[Notes]		
Directory=/home/nadmb2/notesdata		

```

KitType=2
SetupDB=setupweb.nsf
UserName=
CompanyName=
NotesProgram=/opt/lotusr6/lotus/notes/60000/linux
DSTLAW=4,1,1,10,-1,1
SHARED_MAIL=0
Passthru_LogLevel=0
Console_LogLevel=2
DefaultMailTemplate=mail6.ntf
Preferences=32
ServerTasks=Update,Replica,Router,AdminP,CalConn,Sched,HTTP,LDAP
ServerTasksAt1=Catalog,Design
ServerTasksAt2=UpdAll,Object Collect mailobj.nsf
ServerTasksAt3=Object Info -Full
ServerTasksAt5=Statlog
TCPIP=TCP, 0, 15, 0
Serial1=XPC,1,15,0,,4096,19200,32,3c56k.mdm
Serial2=XPC,2,15,0,
Timezone=5
**shortened for example

```

---

```

User (nadmban) Environment Wed Jul 10 11:42:38 EDT 2002
PWD=/home/nadmban/notesdata
WINDOWID=35651735
PAGER=less
uid_list=500
LD_PRELOAD=:/opt/gnome/lib/libgdkxft.so
HOSTNAME=branch
NSD_INP_ARGS=
LESSCLOSE=lessclose.sh %s %s
LS_OPTIONS=-N --color=none -T 0
QTDIR=/usr/lib/qt3
OPENWINHOM=/usr/openwin
_SUSECONFIG_PROFILE=true
LESSKEY=/etc/lesskey.bin
LESSOPEN=lessopen.sh %s
JAVA_BINDIR=/usr/lib/java/bin
MANPATH=/usr/local/man:/usr/share/man:/usr/X11R6/man:/opt/gnome/man:/usr/op
**shortened for example

```

---

**Tip:** Do not send the Notes.ini to Lotus Customer Support; it is included in the NSD output!

Next is the list of the Domino binaries directory. This list can help in determining if setuid root is in place for any processes, ownership of the binaries, and any add-ins that might be used on this server.

*Example 4-10 List of Domino binaries directory*

Executable & Library Files										Wed Jul 10 11:42:38 EDT 2002									
-r-xr-xr-x	1	root	daemon	7499589	Jul	9	06:48	/opt/lotus/notes/latest/linux/adminp											
-r-xr-xr-x	1	root	daemon	138608	Jul	9	06:46	/opt/lotus/notes/latest/linux/amgr											
-r-xr-xr-x	1	root	daemon	28575	Jul	9	06:46	/opt/lotus/notes/latest/linux/autodial											
-r-xr-xr-x	1	root	daemon	39492	Jul	9	06:46	/opt/lotus/notes/latest/linux/billing											
-r-sr-xr-x	1	root	daemon	8944	Jul	9	06:47	/opt/lotus/notes/latest/linux/bindsock											
-r-xr-xr-x	1	root	daemon	80514	Jul	9	06:47	/opt/lotus/notes/latest/linux/ca											
-r-xr-xr-x	1	root	daemon	31574	Jul	9	06:48	/opt/lotus/notes/latest/linux/calconn											

System information contains the hard and soft limits for the Notes user and the machine.

*Hard limits* are absolute limits set server-wide, which users cannot override, while *soft limits* pertain only to the users in whose environment the soft limits are set.

For instance, if the hard core limit is set to 2 MB and the soft limit is set to 10 MB for the Domino user, the Domino user will not be able to generate a core beyond 2 MB in size.

Limits can be set in the file `/etc/security/limits.conf`.

*Example 4-11 Hard and soft resource limits*

---

Resource Limits:

=====

Soft/Current Limits:

=====

core file size (blocks)	0
data seg size (kbytes)	unlimited
file size (blocks)	unlimited
max locked memory (kbytes)	unlimited
max memory size (kbytes)	unlimited
open files	1024
pipe size (512 bytes)	8
stack size (kbytes)	unlimited
cpu time (seconds)	unlimited
max user processes	4092
virtual memory (kbytes)	unlimited

Hard Limits:

=====

core file size (blocks)	unlimited
data seg size (kbytes)	unlimited
file size (blocks)	unlimited
max locked memory (kbytes)	unlimited
max memory size (kbytes)	unlimited

open files	1024
pipe size (512 bytes)	8
stack size (kbytes)	unlimited
cpu time (seconds)	unlimited
max user processes	4092
virtual memory (kbytes)	unlimited

Next is the version of the operating system and flavor of Linux (Example 4-12), followed by swap information (Example 4-13).

*Example 4-12 Linux version*

```
Linux Version:
=====
Linux version 2.4.18-64GB-SMP (root@SMP_X86.suse.de) (gcc version 2.95.3
20010315 (SuSE)) #1 SMP Wed Mar 27 13:58:12 UTC 2002
```

*Example 4-13 Swap info*

```
Swap Info:
=====
```

Filename	Type	Size	Used	Priority
/dev/hda1	partition	1028120	0	42

System Configuration shows physical memory on the machine, number and types of processors, uptime, load average, and some kernel configuration information.

Local Disks shows disk volumes mounted and space remaining, followed by current patches applied to the server. It is similar to a **df -k** command.

*Example 4-14 Local disk information*

```
Local Disks:
=====
```

Filesystem	1024-blocks	Used	Available	Capacity	Mounted on
/dev/hda3	5162828	4594096	306472	94%	/
/dev/hda4	16160292	3356360	11983012	22%	/home
shmfs	256136	0	256136	0%	/dev/shm

VMstats shows a ten-second snapshot of the CPU statistics. This often shows plenty of idle time, since an NSD is most commonly gathered for a crash condition where the server is completely down.

This can be useful for performance and hangs, where the NSD is taken during the performance problem.

Example 4-15 CPU Statistics

VM Stats:

=====

Virtual Memory (last 10 secs):

=====

procs				memory			swap		io		system			cpu	
r	b	w	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id
7	0	0	0	99960	45188	184288	0	0	7	6	249	1273	33	35	33
3	0	0	0	99952	45188	184288	0	0	0	0	227	779	50	50	0
3	0	0	0	99960	45188	184288	0	0	0	0	312	812	51	49	0
2	0	0	0	99952	45188	184288	0	0	0	0	358	897	51	49	0
1	0	0	0	99952	45188	184288	0	0	0	184	284	617	41	59	0
2	0	0	0	99952	45188	184288	0	0	0	0	227	589	45	55	0
2	0	0	0	99952	45188	184288	0	0	0	0	203	555	40	60	0
3	0	0	0	99952	45188	184288	0	0	0	0	241	624	45	55	0
2	0	0	0	99952	45188	184288	0	0	0	0	211	581	45	55	0
3	0	0	0	99952	45188	184288	0	0	0	0	204	538	50	50	0

Network info gives a lot of information on the state of the network, and also lists the current connections to the server by IP.

Process list gives a complete list of system-wide processes. This can show other processes running in addition to Domino; one or more of these could potentially be conflicting with the Domino application.

For instance, if Apache (a public domain Web server) is running, you will be able to see that here. Since Apache and the HTTP process both default to running on port 80, they could potentially conflict with each other and cause problems.

Data directory gives a full listing of the data directory and subdirectories, as well as their ownership and access rights.

**Note:** You can check the size of your full-text index databases here as well.

Example 4-16 Data directory full listing

Data Directory Full Listing:

=====

457033	-rw-r--r--	1	nadmb2	notes	341504	Sep 12 05:05	billing.ntf
457034	-r--r--r--	1	nadmb2	notes	905	Aug 20 1996	binary.gif
457044	-rw-r--r--	1	nadmb2	notes	4489216	Sep 12 05:05	bookmark.ntf
1321926	drwxr-xr-x	2	nadmb2	notes	4096	Sep 9 15:33	subdir/

## Memcheck

Next we have the memcheck portion of the NSD. Memcheck is a tool that is installed by default in Domino 6 and is called by the NSD script, but it can also be run manually. For details about the memcheck options run `<memcheck -h>`. This will yield information about usage of the command and available options.

### *Open databases in memcheck*

One of the best features of the memcheck output is to show, for each Domino process/thread, which Domino databases are being used.

You have to search for the string "Open Databases" in the NSD output file; you can see some lines in Example 4-17.

#### *Example 4-17 Open databases*

---

```
----- Open Databases -----
/home/nadmb2/notesdata/busytime.nsf
  Version      = 43.0
  SizeLimit    = 0, WarningThreshold = 0
  ReplicaID    = 85256c30:0071e6f8
  bContQueue   = NSFPool [ 2: 15364]
  FDGHandle    = 0xf01c0139, RefCnt = 1, Dirty = N
  DB Sem       = (FRWSEM:0x0244) state=0, waiters=0, refcnt=0, nlrdrs=0 Writer=[]
  SemContQueue ( RWSEM:#0:0x029d) rdcnt=-1, refcnt=0 Writer=[] n=0, wcnt=-1, Users=-1, Owner=[]
By: [ sched: 2150: 2] DBH= 59, User=CN=bark/0=tree
```

---

The example shows that the busytime.nsf database is opened by sched process 2150 thread 2.

This information can be matched with an eventual stack trace of the faulting thread to produce a preliminary diagnosis on an eventual corrupted database that generated the server crash.

**Note:** This is a possible starting point to troubleshoot the problem; a confirmation from Lotus Customer Support must also be done.

The last section contains any errors that may have been generated by NSD during its execution. Some of these errors are really informational and not necessarily indicative of a problem, even if they are listed as a warning.

Generated Info/Warnings/Errors are shown in Example 4-18 on page 245.

*Example 4-18 Viewing messages*

---

Generated Info/Warnings/Errors:

- (1) INFO: Generating binary list file  
./nsd.nadmb2/nsd\_V60\_09082002\_cache.ins.lst
  - (2) INFO: Generating cache file ./nsd.nadmb2/nsd\_V60\_09082002\_cache.ins
  - (3) INFO: The Maximum core file size is 0 blocks
-







## Domino in action

In this chapter, we describe some of the capabilities of the Domino server and the strengths of Domino 6. We selected several features to demonstrate from among the many that are part of Domino 6. The features presented in detail are:

- ▶ Domino user registration
  - The Domino Administration client within Linux
  - The Web Administration interface
  - Active Directory synchronization with the Lotus ADSync tool
- ▶ Accessing external data from a Domino application
  - Using a sample application to connect to DB2
  - Using a sample application to connect to MySQL

## 5.1 Domino user registration

Once your Domino server is installed and configured, you must register users before they can set up their Notes client. User registration creates the following for each user:

- A Person document in the Domino Directory
- A User ID containing the appropriate certificates
- A mail file

The process of registering users can be performed using any of the following methods:

- Domino Administration client
- Java-compliant browser with the Web Administrator interface
- Active Directory Users and Groups Console utilizing a new Domino 6 feature for Active Directory Synchronization.

We do not discuss here the various planning and management aspects of user registration (for example, policy creation, roaming users, and so forth). Instead we are addressing only the methods for performing user registration.

### 5.1.1 Domino Administration client

We chose to use the Domino Administration client within the Linux server running Domino to demonstrate user registration without using a Windows workstation. You can accomplish the same thing using the Domino Administration client on a Windows machine.

The Domino Administrator client does not run natively on the Linux platform; therefore, we must emulate a Windows environment. There are numerous products on the market to accomplish this. We chose CrossOver Office (the commercial version of Wine, [www.winehq.org](http://www.winehq.org)) from CodeWeavers, Inc. which does not require a Windows workstation. The CrossOver Office package can be obtained directly from the CodeWeavers Web site at:

<http://www.codeweavers.com>

**Attention:** CrossOver office *only* runs under X-Windows on an IA32-based system. We installed Pre-Release 1 of Domino Administration client since that was the most current version available at the time of writing. Furthermore, minimal testing with the Release Candidate version was done, but it did not seem to work with CrossOver office or Wine. This is probably due to a change of installer program. Hopefully CodeWeavers will address this issue in future releases of CrossOver office.

## Installing CrossOver Office

Installing the CrossOver Office product is a simple process that only takes a few minutes. It can be installed either as a normal user, or as root to create a multi-user environment. We chose to install the product as a root user. You can see this in the setup dialog box, shown in Figure 5-1. Your decision should be strictly based on your license for the product.

CrossOver Office is installed by invoking the script which we purchased and downloaded from the CodeWeavers Web site. The *version* represents the version you downloaded. We worked with version 1.0.0 of the product. The command you need to issue to start the installation is:

```
sh install-crossover-office-version.sh
```

Once the installation script starts, the following window is displayed.

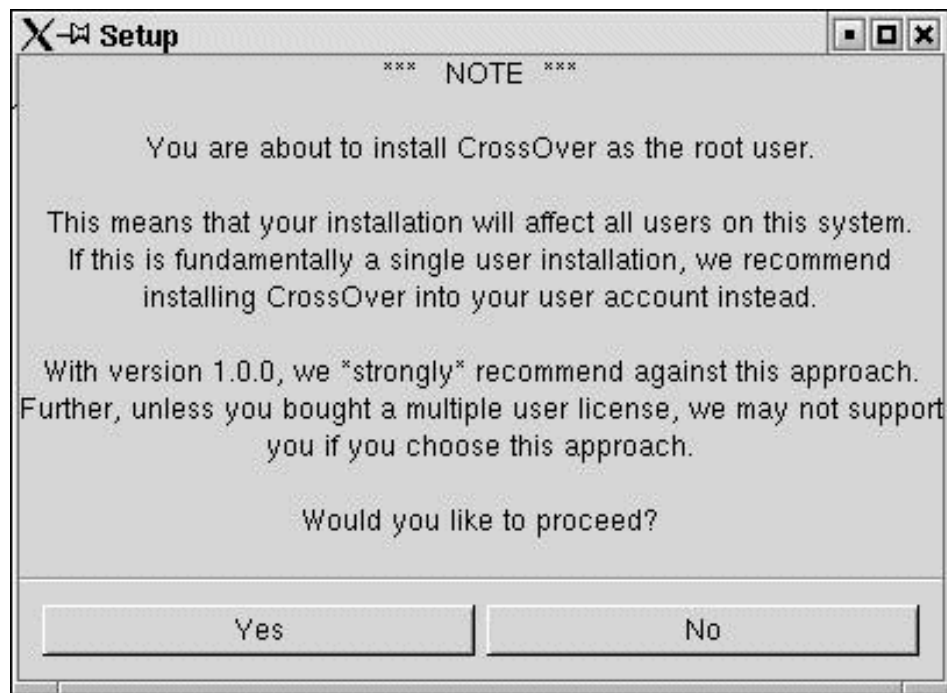


Figure 5-1 CrossOver Office setup

The script decompresses CrossOver Office and installs the components onto your Linux system. Click **Yes** in the setup dialog box to install under the root account. Click **I Agree** after reading the license agreement (Figure 5-2).

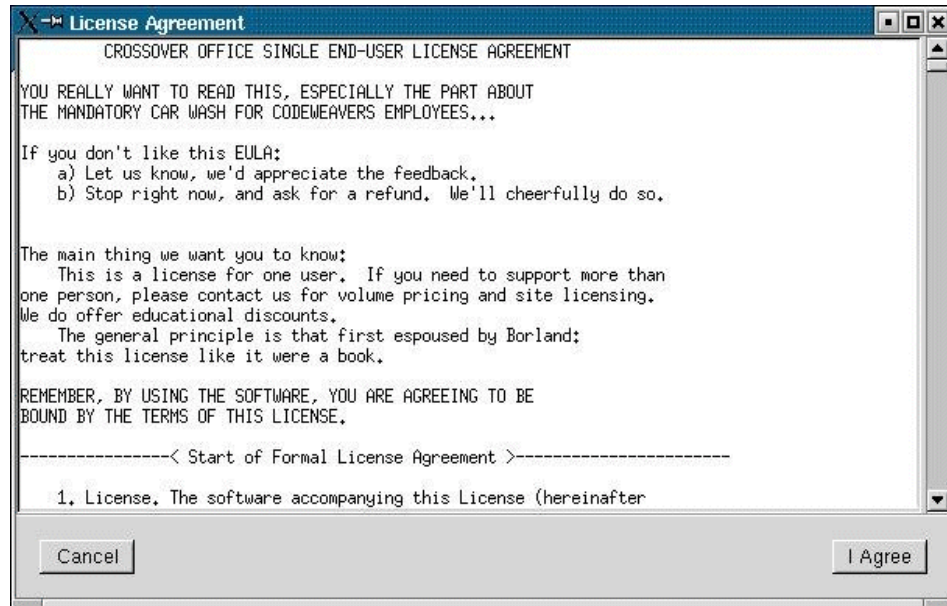


Figure 5-2 CrossOver Office License Agreement

You are then prompted for the installation directory. Since we chose the root user installation, our files will be installed in the `opt/cxoffice` directory. If you choose Normal user during the installation, the CrossOver Office files will be installed in the user's home directory. Click the **Begin Install** button to initiate the file copy portion of the installation (see Figure 5-3).

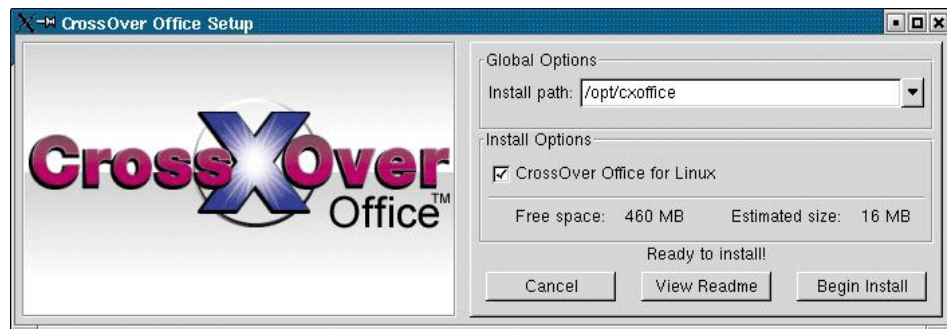


Figure 5-3 CrossOver Office Install Path

When the installation completes you are presented with the window shown in Figure 5-4, which provides an opportunity to review the Readme file.



Figure 5-4 CrossOver Office install complete

At this point you can configure the CrossOffice product for your environment by clicking the **Configure Now** button displayed on the screen. You will be presented with the welcome screen shown in Figure 5-5.

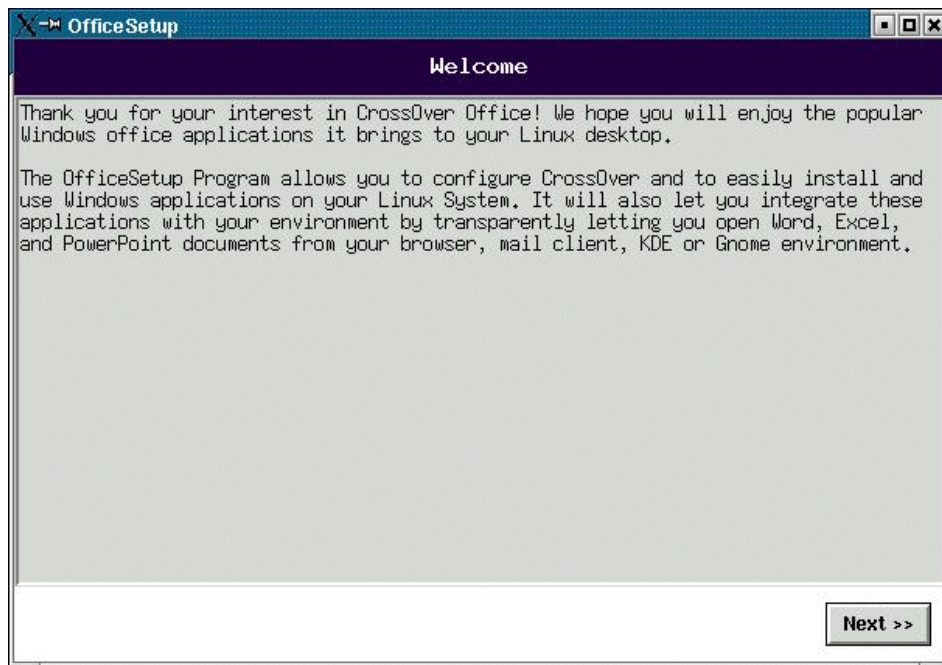


Figure 5-5 CrossOver Office setup: Welcome screen

Click **Next** to continue.

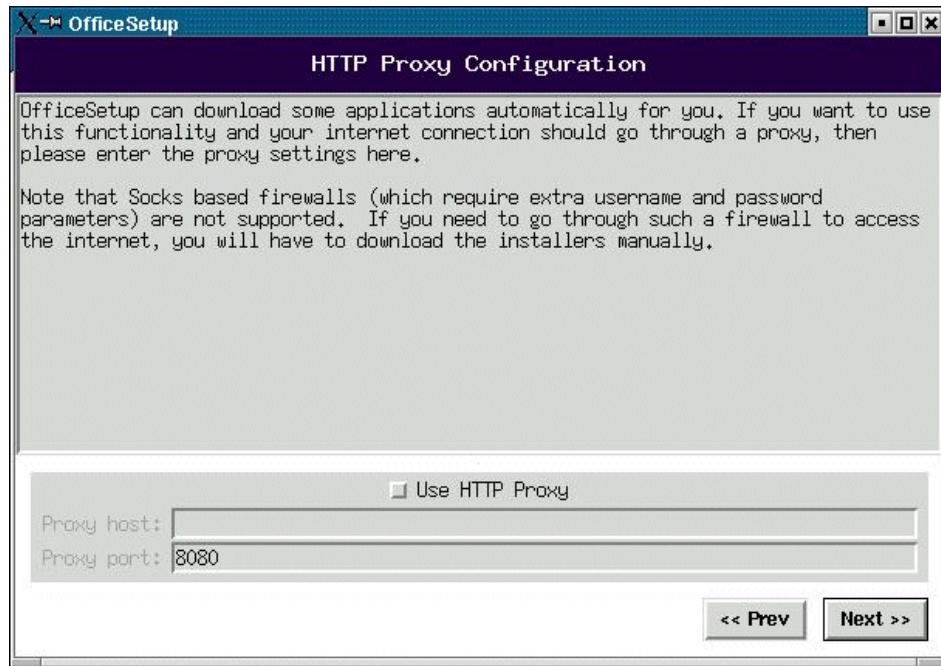


Figure 5-6 CrossOver Office HTTP Proxy Configuration screen

After completing the HTTP proxy fields, click **Next**. The configuration portion of the installation program will execute.

### Installing the Lotus Notes client on Linux

Once CrossOver Office is configured, you can install the Domino Administration Client. By default, the CrossOver Office setup has line items for Microsoft Office, Lotus Notes, and Other. Select **Lotus Notes**, then click **Add** (Figure 5-7).



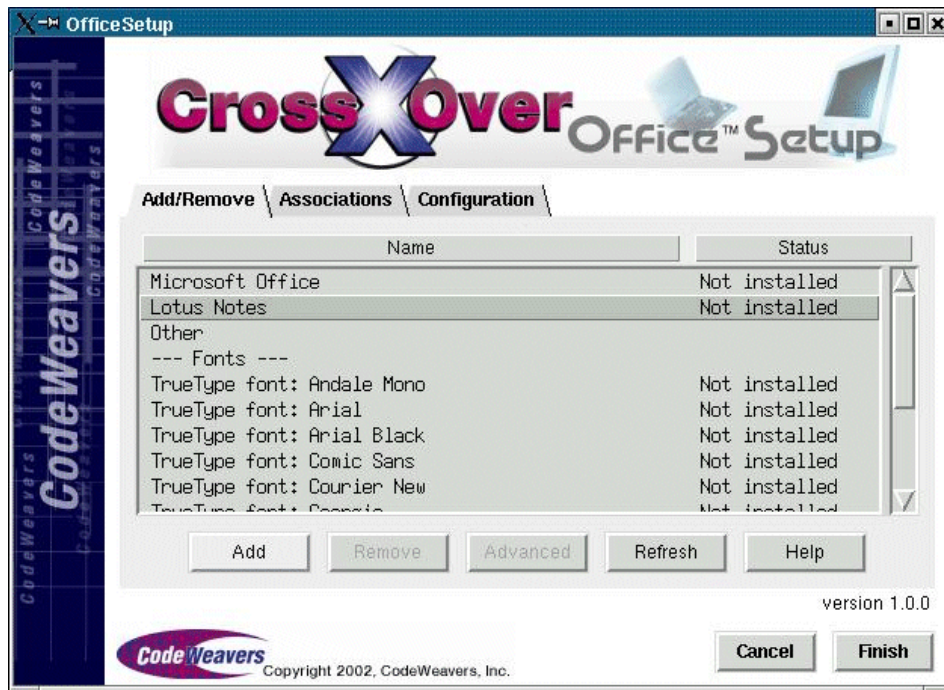


Figure 5-7 CrossOver Office: Add application

On the next screen, shown in Figure 5-8, choose your method of installation: either CDROM or an executable file. Since we downloaded our Notes client code from Notes.Net, we chose the executable. At the time of this writing, the CrossOver Office product only supported version 5 of Notes; however, we chose to install Domino 6. Click the **Browse** button to navigate to your install program.

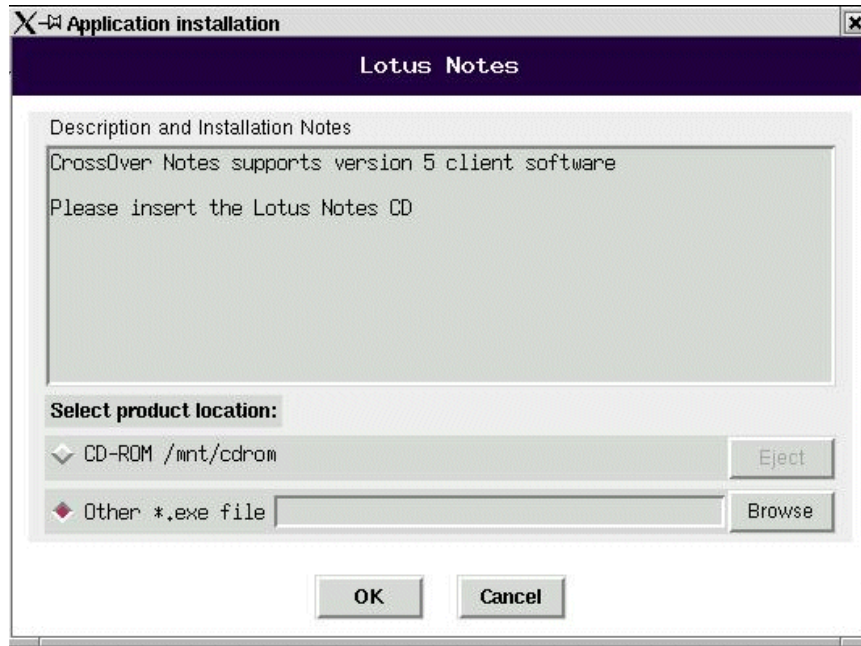


Figure 5-8 CrossOver Office: Application installation

Select the appropriate file and click **Open** to begin the installation of the Notes client.

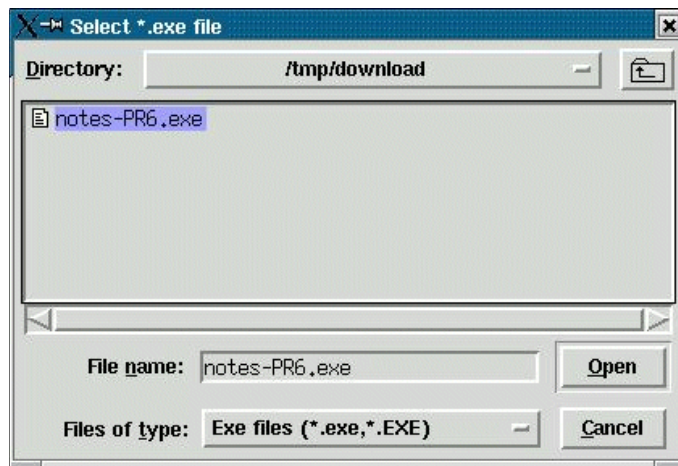


Figure 5-9 CrossOver Office: Select \*.exe file



At this point you are presented with the Lotus Notes installation screens.

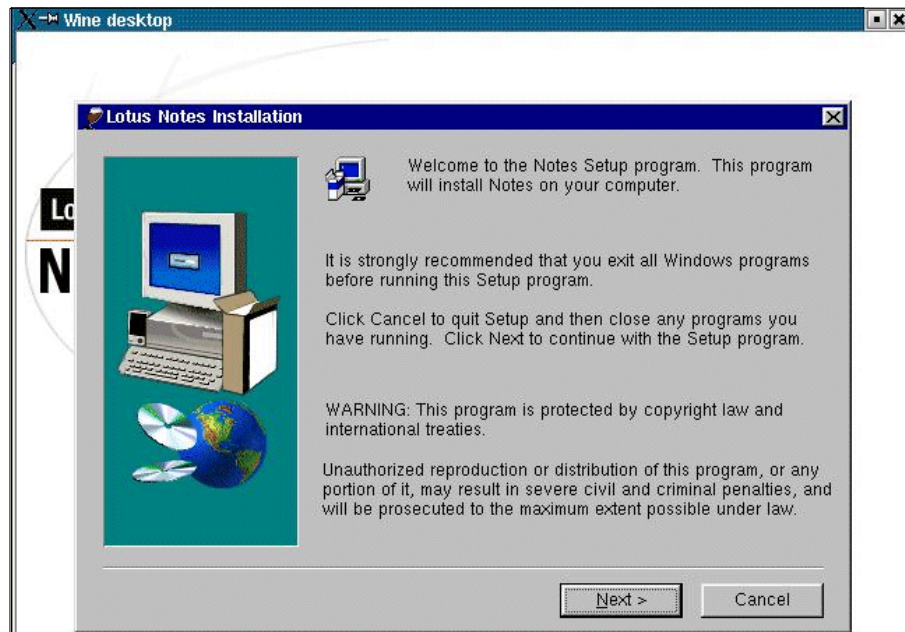


Figure 5-10 Lotus Notes Installation: Welcome

Click **Next** to review the software license agreement. After reviewing the agreement, click **Yes** continue or **No** to exit the installation.

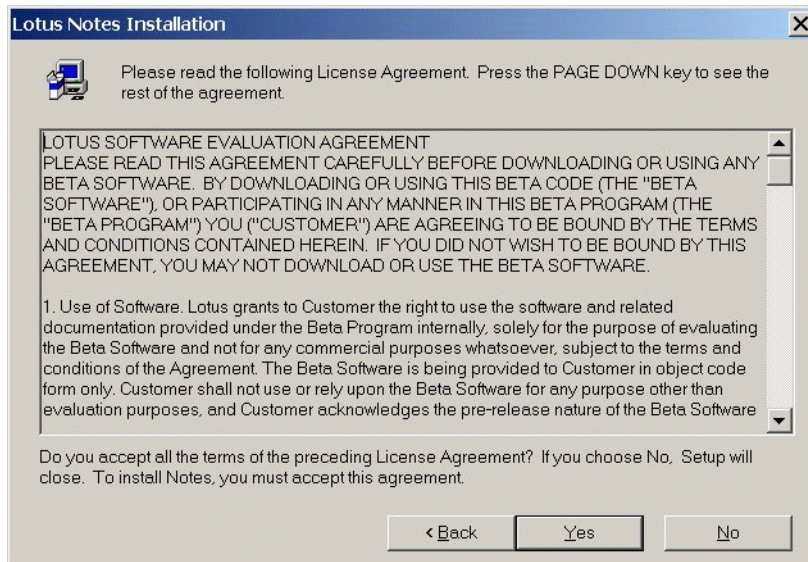


Figure 5-11 Lotus Notes Installation: License Agreement

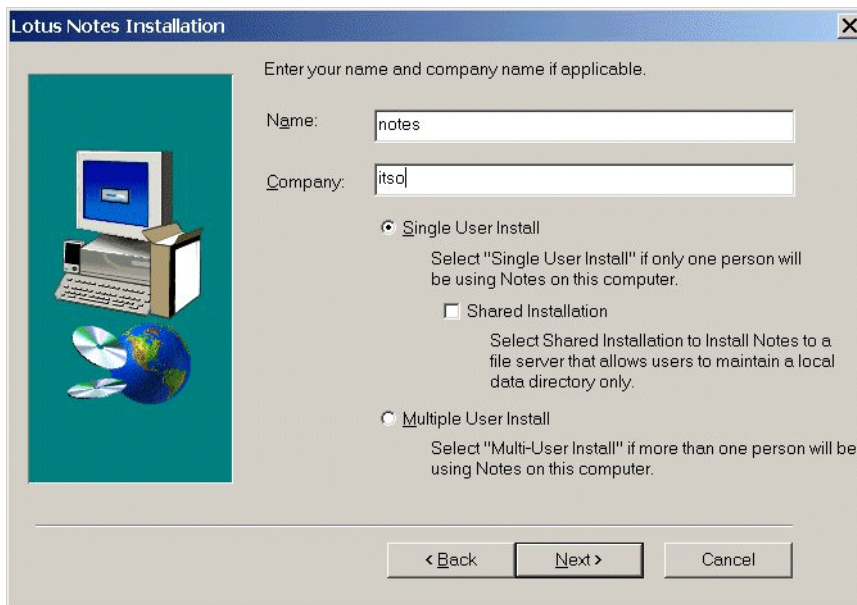
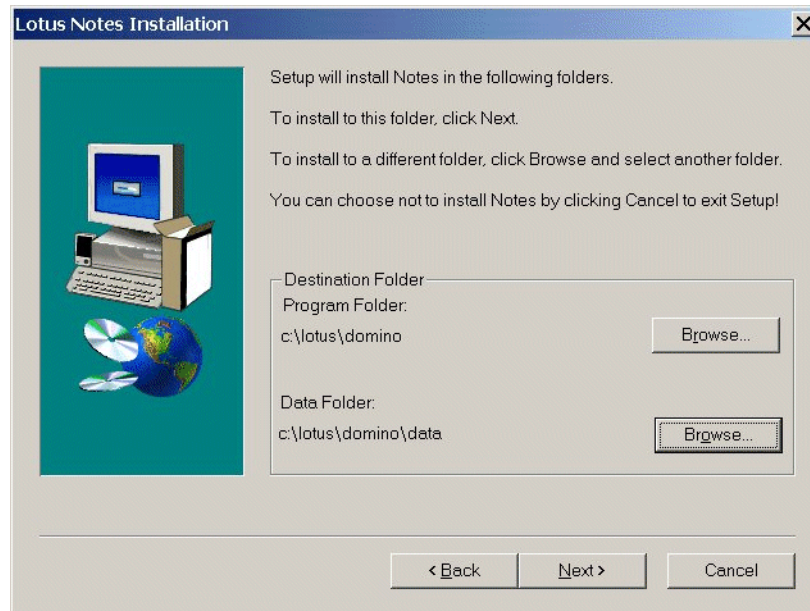


Figure 5-12 Lotus Notes Installation: Single/multiple user install

Enter the user name and the name of your company. See the Release notes of Lotus Notes/Domino for further discussion about what to use as a user name.



*Figure 5-13 Lotus Notes Installation: Destination folder*

Choose your destination folders for the Lotus Notes program and data files. Click **Next** to continue.

**Note:** As you can see in Figure 5-13, the target installation directory is `c:\lotus\domino` as opposed to `c:\lotus\notes`. This is the default setting within the CrossOver Office product, although we are installing the Notes client. You might want to choose a different directory.

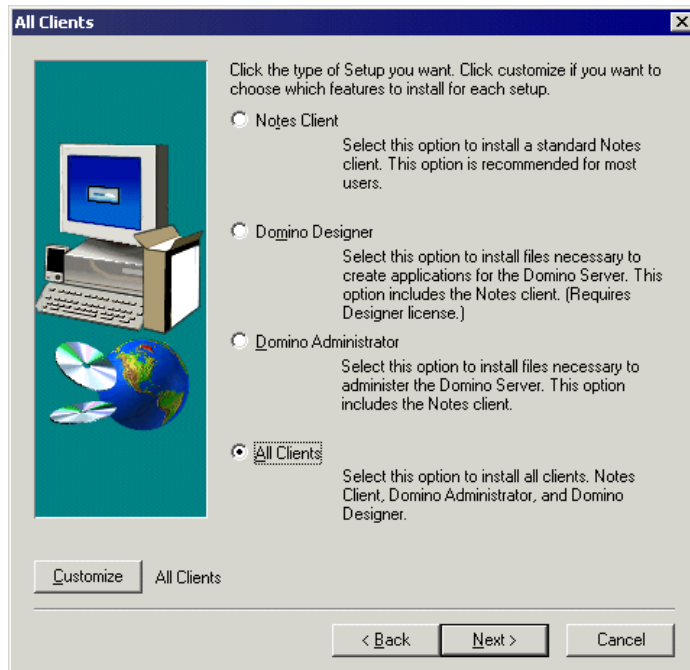


Figure 5-14 Lotus Notes Installation: Client selection

Select which client you would like to install and click **Customize** to modify the default installation settings for your client selection. By default, the Notes Client is chosen. For our purposes, we chose All Clients.

Click **Next** to continue.



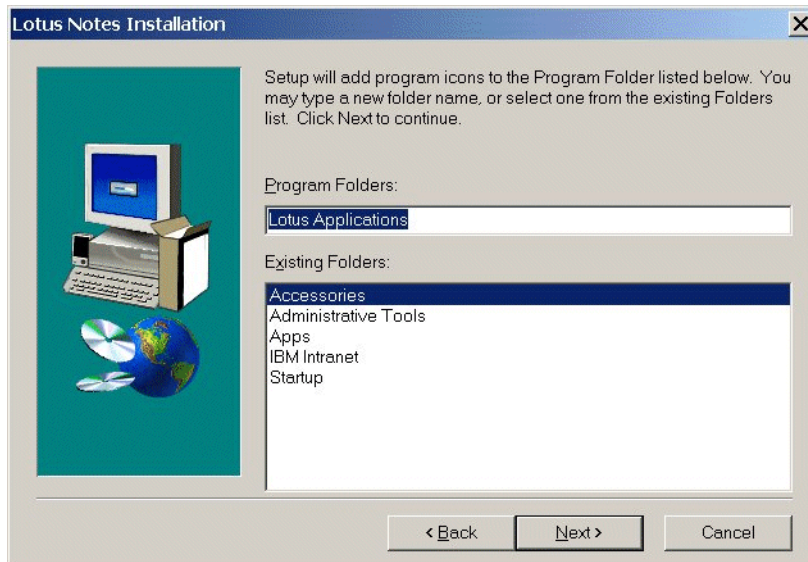


Figure 5-15 Lotus Notes Installation: Program folders

Figure 5-15 shows your last installation dialog. Choose the program folder for your application shortcuts, then click **Next** to begin the file copying process.

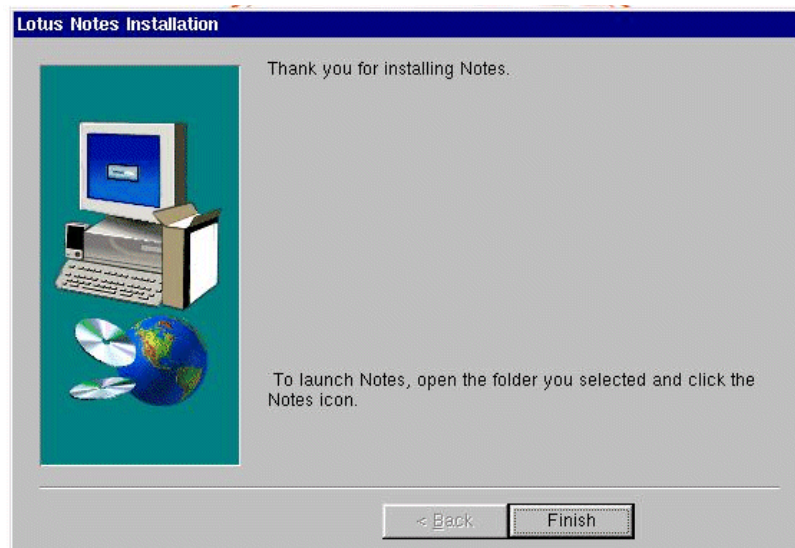
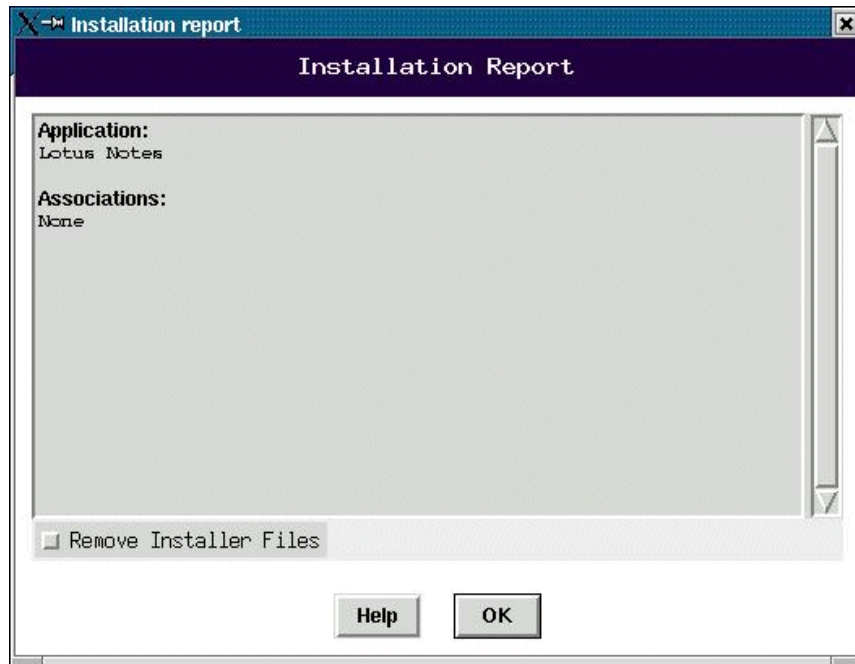


Figure 5-16 Lotus Notes Installation: Complete

Following the successful installation of the Notes client software, CrossOver Office presents you with an installation report as shown in Figure 5-17.



*Figure 5-17 CrossOver Office Installation Report*

At this point we ran the normal Notes client setup to connect to our Domino 6 server and copy the administrator's ID to our Notes/Data directory. Before using the client for the first time, we chose to reboot the Linux workstation we were using for Domino administration. This is based on the fact that we had installed several software applications and wanted to start with a fresh system.

Once Linux restarted, we verified that the Domino 6 server was running, then started the Domino Administration client. During the installation process of the Notes client, CrossOver Office adds a Lotus Applications group to Programs in the KDE start menu, emulating the placement in a Windows environment. See Figure 5-18 on page 261. Just as in Windows, this shortcut may be copied to the KDE desktop for quicker access.

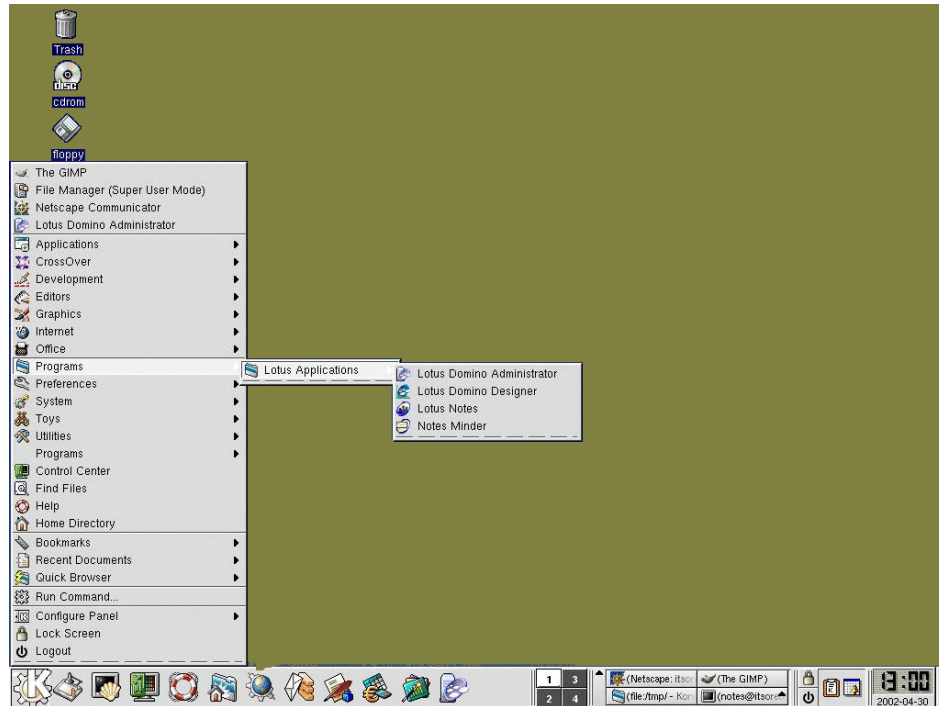


Figure 5-18 KDE start menu: Lotus Applications program group

Now you are ready to register users or perform any other administrative tasks, in a non-Windows environment, using the Domino Administration client.

## 5.1.2 The Web administrator

The Web Administrator uses the Web Administrator database (WEBADMIN.NSF). This database is automatically generated the first time the HTTP task is started, and is placed in the data directory of the Domino server. For the Linux platform this is the /local/notesdata directory.

**Note:** Web Administrator browser support is limited to Netscape 4.7x and Microsoft Internet Explorer 5.5+. Other Java-compliant browsers such as Opera and Mozilla may work, but they were not supported at the time of writing.

**Note:** Refer to the Lotus Domino Administrator 6 Help for additional information on setting up the Web Administrator database. The Web Administration client is discussed in 3.4.1, “Domino 6 Web Administrator” on page 177.

Using the Web Administrator, most of the tasks available through the Domino Administration client can now be performed from your browser with no extra setup tasks. However, in order to register users from the Web Administrator you must have access to a Notes Certifier. You have this access from the Domino Administration client, but not from the Web Administrator. The Certificate Authority process in Domino is designed to let you register users without direct access to the Notes Certifier ID by securely delegating this permission to selected users. To use the Certificate Authority process, you must migrate the Notes Certifier.

### **Migrate the certifier**

When you installed the first Domino server you created a Notes certifier for issuing Notes certificates. This certifier is capable of using either a keyring file or the Certificate Authority process. We chose the Certificate Authority process in lieu of creating a keyring.

**Note:** The Certificate Authority is the link that allows a client and server to communicate using SSL and to exchange mail with S/MIME. The server and the client authenticate with each other by identifying the digital signature on their trusted certificate. Refer to the Lotus Domino Administrator 6 Help for information on the Certificate Authority and public key encryption.

The migration requires the Domino Administration client. Since we have already installed the client within CrossOver Office, we can perform the migration locally without working from a Windows workstation.



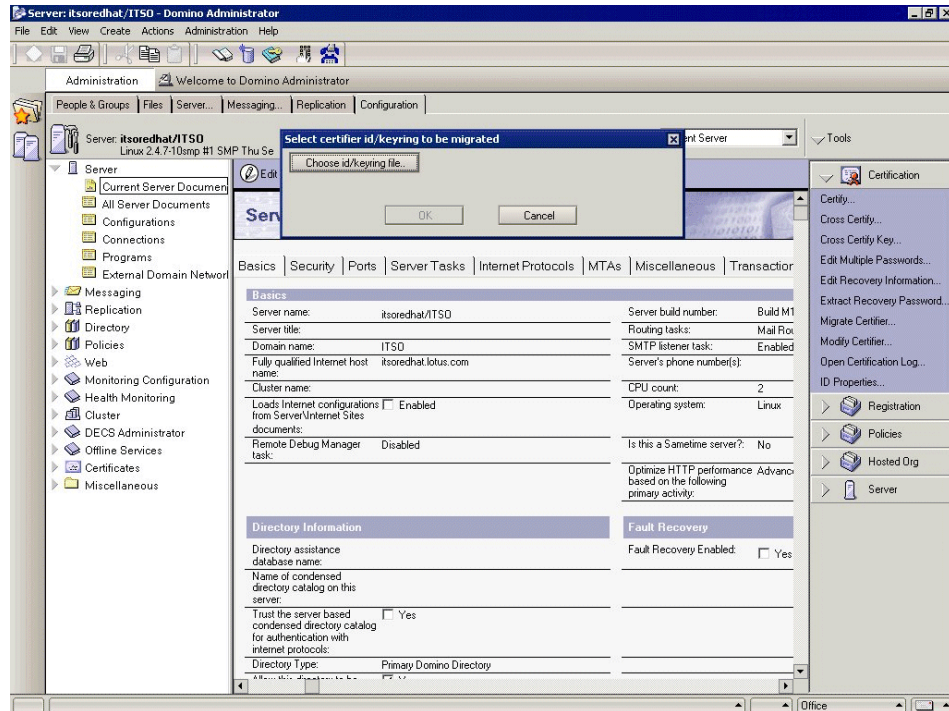


Figure 5-19 Domino Administration client: Migrate certifier

Using the Domino Administration client, select the server and click the **Configuration** tab. Using the Tools pane, select **Certification -> Migrate Certifier**. You will be presented with a dialog box as shown in Figure 5-19 asking you to select the certifier/keyring to be migrated. Click the **Choose id/keyring file** button.

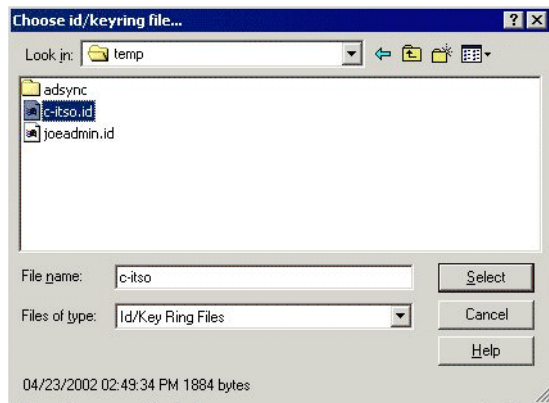


Figure 5-20 Domino Administration client: Choose certifier

Navigate to a correct directory and select your certifier ID file (see Figure 5-20). Click **Select**.

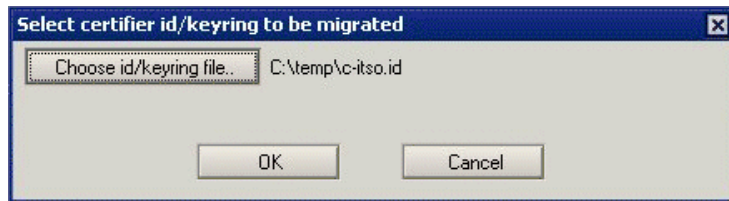


Figure 5-21 Domino Administration Client: Certifier file confirmation

Click **OK** once the appropriate ID file has been chosen.

You are then prompted for the certifier password. Enter the password and click **OK** to continue.

You can then choose an encryption option suitable for your company's security requirements.

Table 5-1 Encryption options

Option	Security Level	Password Required	Action Required
Encrypt ID with Server ID	Lowest	None	None
Encrypt ID with Server ID	Medium	Server ID password	Activate certifier with <b>tel1 ca &lt;param&gt; &lt;password&gt;</b> command
Encrypt ID with Lock ID	Highest	Registered user(s) ID and password	Lock Certifier with <b>tel1 ca lock &lt;idfile&gt;</b> command

**Note:** Refer to the Lotus Domino Administrator 6 Help for additional information, security options, and certificate duration information for migrating a Notes Certifier to the CA process.

Once these selections are made, click **OK** and the certifier migration is complete. For our demonstration environment, we chose to use the Domino administrator's ID file.

**Migrate 0=ITSO**

**Basics** | Certificates

Migrate certifier with id/keyring: C:\temp\c-itso.id

Select the server where this certifier will run on: itsoredhat/ITSO

Name of ICL database to be created: ic\icl\_9921.nsf

How this certifier is protected

Encrypt certifier ID with: ☒ Locking ID ☐ Server ID

Locking Id... Joe Admin/ITSO

☐ Require password to activate

Password: [ ] Re-enter Password: [ ]

Administrator(s)

CA	RA	Name
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Joe Admin/ITSO

Add...  
Delete  
List of administrators

OK Cancel

Figure 5-22 Domino Administration client: Migrate certifier basics

At this point you are ready to register users in a non-Windows environment using a browser and the Web Administrator. Begin by pointing your browser to:

<http://servername/webadmin.nsf>

Figure 5-23 on page 266 shows the Web Administrator with the People view open. You can start registering users by clicking the **Register** link under People in the Tools pane. For more information refer to “Registering users” in the Domino 6 Administration Help database.

We demonstrate alternative ways to register users for Domino in “Registering users in Domino from Active Directory” on page 277 and “Registering users to Active Directory from Domino” on page 282.

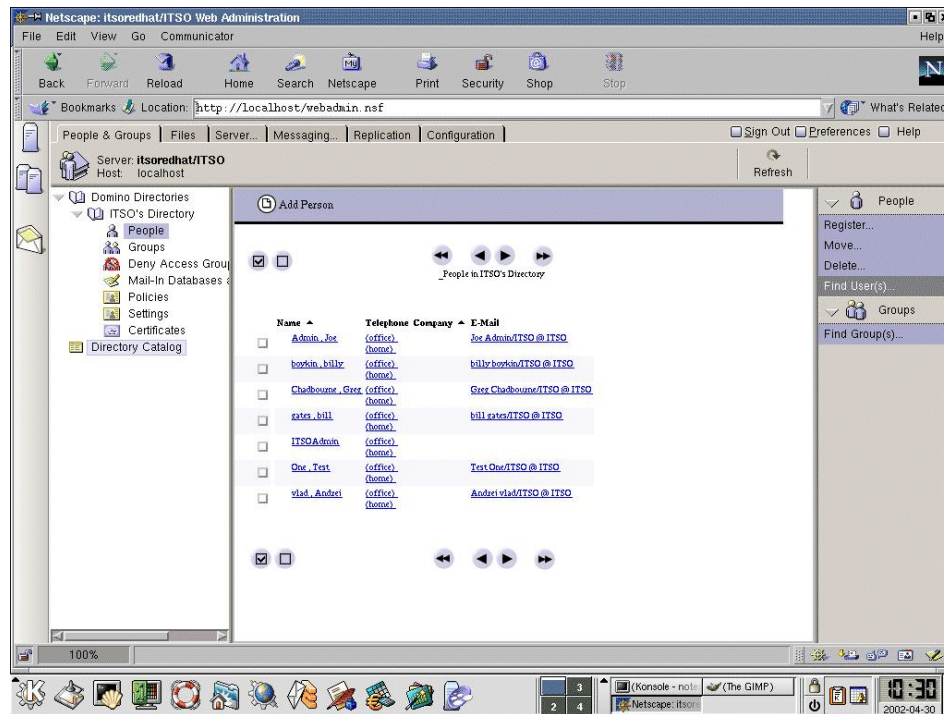


Figure 5-23 Web Administrator: People view

## 5.2 Active Directory synchronization

Domino administrators working in a Windows 2000 environment with Active Directory can now administer users and groups from a single administrative interface of their choice: the Domino Administration client or Windows 2000 Active Directory Users and Computers. This new feature of the Domino 6 server, ADSync lets you keep both the Domino Directory and Active Directory current without having to manually update both with changes. This synchronization feature allows a Domino administrator to securely and precisely delegate the responsibility for Domino user and group management to the network administrators who manage these details in Active Directory.

You can create new users and groups in Active Directory and have those changes reflected in the Domino Directory, including the creation of person or group documents, Notes IDs, passwords, and mail files for the users, as well as

moving users between OUs. In order to accomplish these tasks, the Active Directory administrator must have a properly certified Notes ID and appropriate access to make changes in the Domino Directory. The registration server must be Domino 6 or later and the Domino Administration client must also be a Domino 6 or later client. Additionally, policies must be created that contain subpolicies, either implicit or explicit, for all Domino certifiers where users will be created. Finally, you must have the appropriate rights in Active Directory to add users and groups, and synchronize passwords.

**Note:** Refer to the Lotus Domino Administrator 6 Help for information on policies and subpolicies.

For demonstration purposes, you can install Active Directory, Domino Server, and the Domino Administration client on a single workstation. In a production environment, the Domino server and the Active Directory will likely be installed on separate servers.

**Note:** If you install all components on a single workstation for demonstration purposes, you must change the LDAP port settings for either Active Directory or Domino. By default, both will be listening on port 389; therefore, one of the two will fail to function properly.

For our purposes we used a Domino server running on Linux and a separate Windows 2000 Server with Active Directory and the Domino Administration Client installed.

The only requirement for utilizing the ADSync tool is to work from a workstation that administers the Active Directory and that also has the Domino 6 Administration client installed.

**Note:** Active Directory synchronization will work regardless of the platform on which the Domino Server is running.

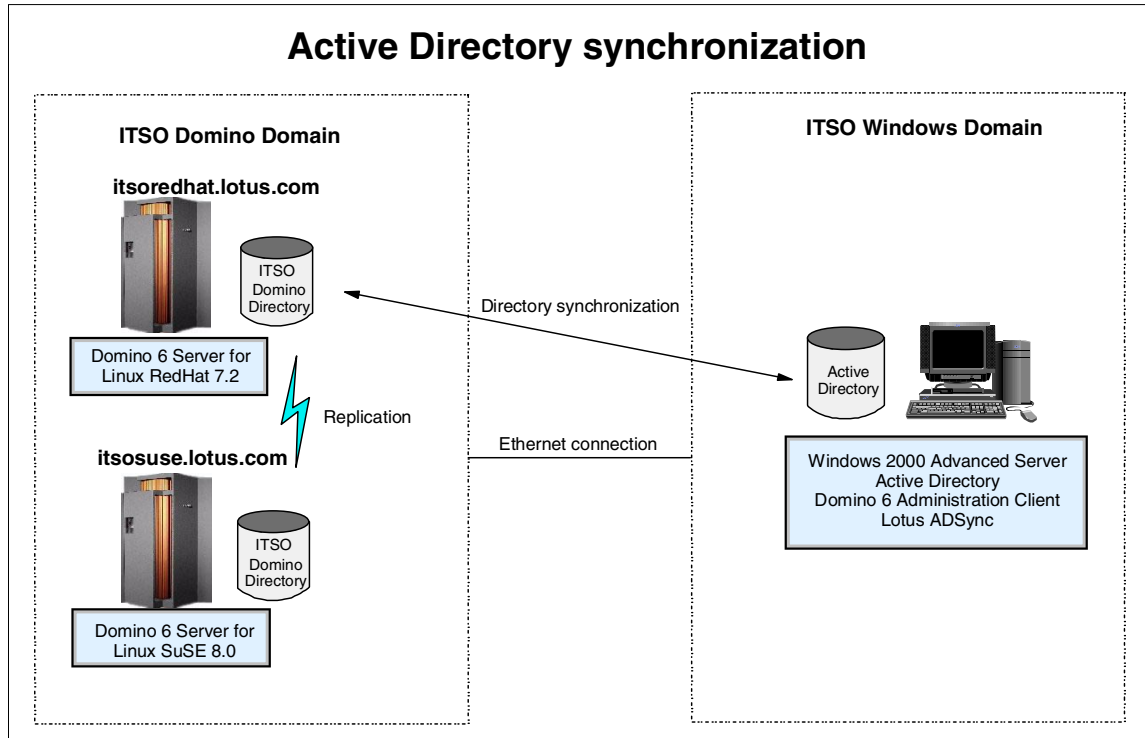


Figure 5-24 Active Directory synchronization: Server diagram

Active Directory synchronization in our demo environment is illustrated in Figure 5-24.

### 5.2.1 Installing the Lotus ADSync tool

In order to use the ADSync tool, you must turn on Domino Directory W2000 Sync Services during the installation of the Domino Administration client. This option is *only* available with the customize button during the Domino Administration client installation.

The synchronization option is not selected by default; therefore, check the appropriate box.

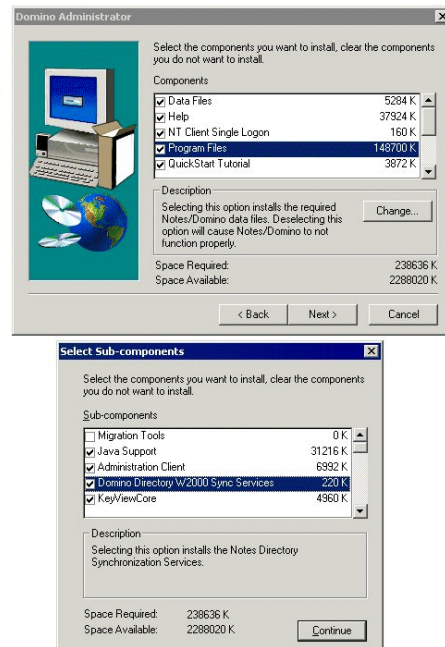
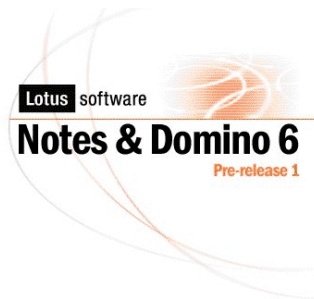


Figure 5-25 Domino Administration client installation: Customize

**Note:** You need to be logged into Windows as an administrator user with full rights to the root domain of the Active Directory forest. Trying to perform the install while logged on as a user without these rights may cause problems and result in an error message.

After installing the Domino Administration client, open a DOS window and navigate to the directory where you installed the client. Enter the following command and press Enter:

```
c:\Program Files\Lotus\Notes> regsvr32 nadsync.d11
```

The command adds a container entry for Lotus Domino Options to the Active Directory Users and Computers management screen and returns the confirmation shown in Figure 5-26.



Figure 5-26 ADsync: RegSvr32

You are now ready to administer users and groups in Active Directory.

## 5.2.2 Creating users and groups in Active Directory

To access Active Directory Users and Computers from your Windows workstation click **Start -> Programs -> Administrative Tools -> Active Directory Users and Computers**. You can initiate Active Directory “actions” in the right-hand results pane, or in the left-hand navigation pane. Domino users and groups are created by either of two methods:

- ▶ In the left pane, right-click an entry and choose your action from the pop-up menu.
- ▶ In the results pane, select one or more users and groups, then select **Register in Domino** from either the context menu, the toolbar, or by right-clicking the entry and using the pop-up menu.

**Note:** Refer to your Windows 2000 documentation for more information about working with Active Directory Users and Computers.

Before you start registering users and groups from Active Directory, you must enable the Lotus Domino Options. Use the following steps to do this.

1. From the Active Directory Container shown in Figure 5-27, double-click the Lotus Domino entry.



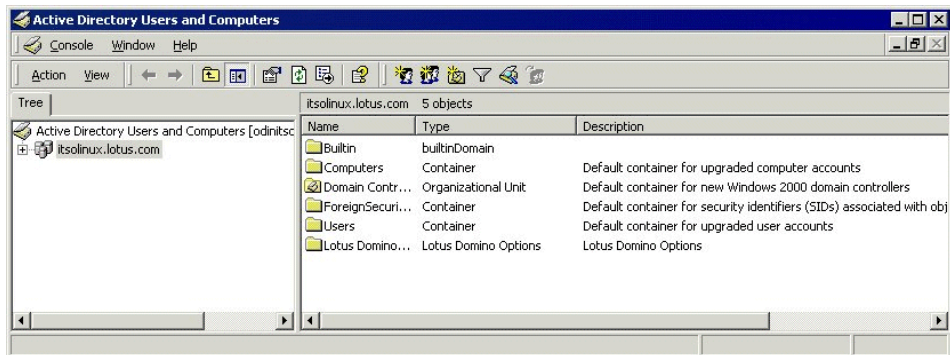


Figure 5-27 Active Directory Users and Computers

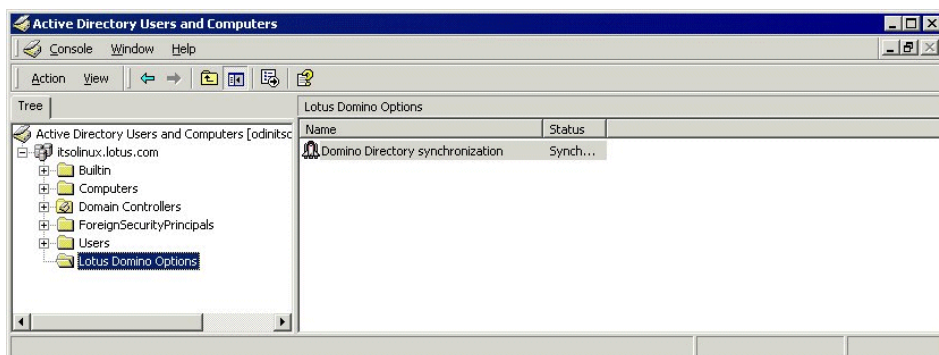


Figure 5-28 Active Directory Users and Groups: Lotus Domino options

2. Double-click the entry for Domino Directory synchronization in the results pane shown in Figure 5-28 to initialize the Lotus ADSync tool. This will require the password for the Domino administrator working from the Active Directory Users and Groups console (see Figure 5-29).

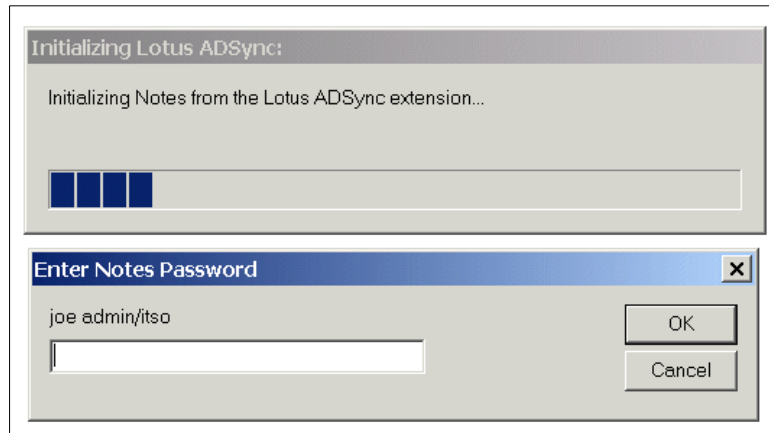


Figure 5-29 Initializing Lotus ADSync

3. You are then prompted to select a Domino server for all Active Directory/Notes user synchronizations (Figure 5-30 on page 272). Select the appropriate Domino server from the drop-down selection box.



Figure 5-30 Lotus ADSync: Choose Domino server

4. If the initialization was successful you should see the window shown in Figure 5-31.

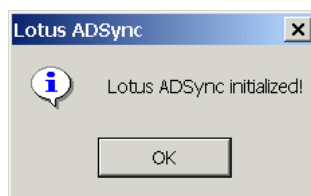


Figure 5-31 Lotus ADSync initialized

With ADSync initialization complete, you have the opportunity to choose several synchronization options, as shown in the next four figures.

**Note:** Refer to the Help files available from the Lotus ADSync Options window shown in Figure 5-32. This window is accessible by right-clicking the **Domino Directory Synchronization** entry and choosing **Options**.

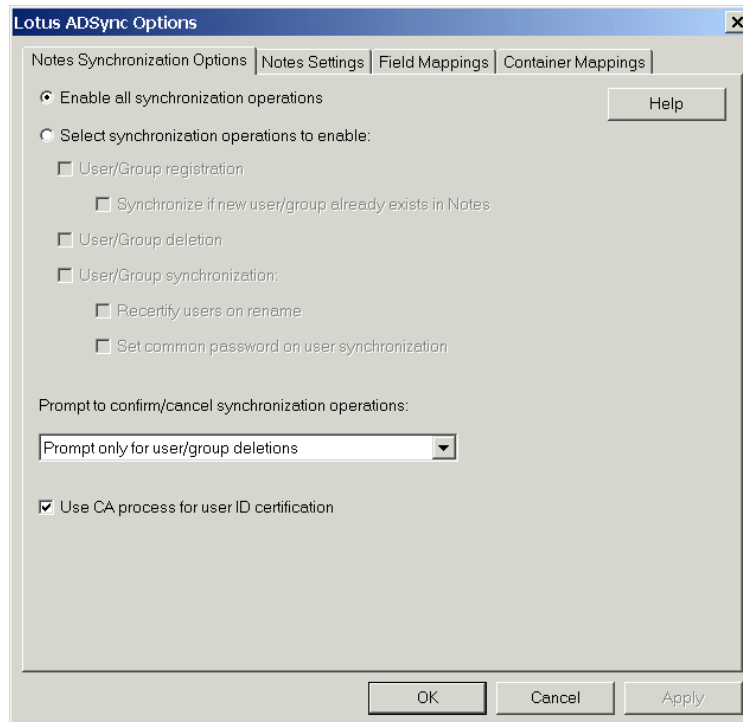


Figure 5-32 Lotus ADSync: Notes synchronization options

From the Notes synchronization options tab you can:

- Enable or disable all synchronization operations
- Customize synchronization options with “Select synchronization operations to enable”
- Configure prompting options from the drop-down selection box
- Choose to use the CA process for user registration

**Important:** The “Use the CA process for user registration” *must* be selected.

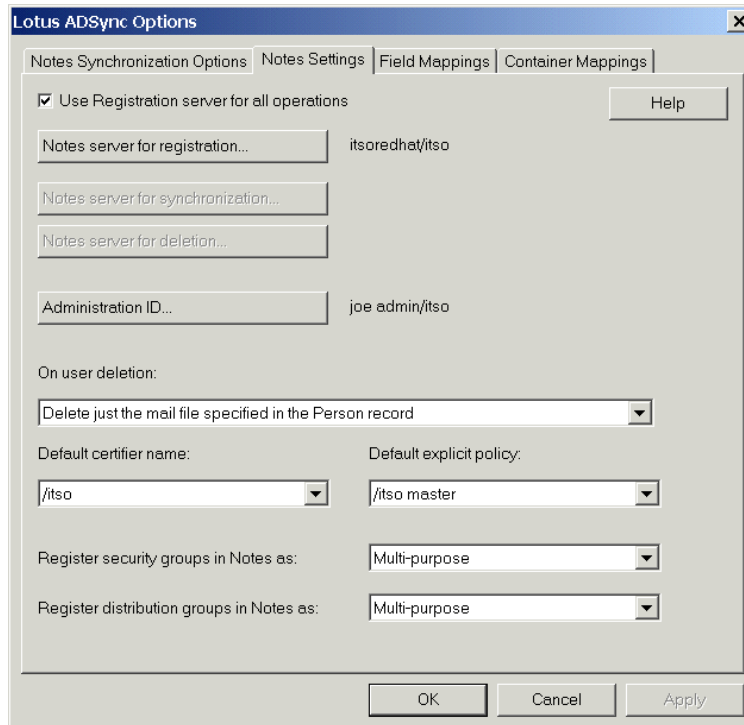
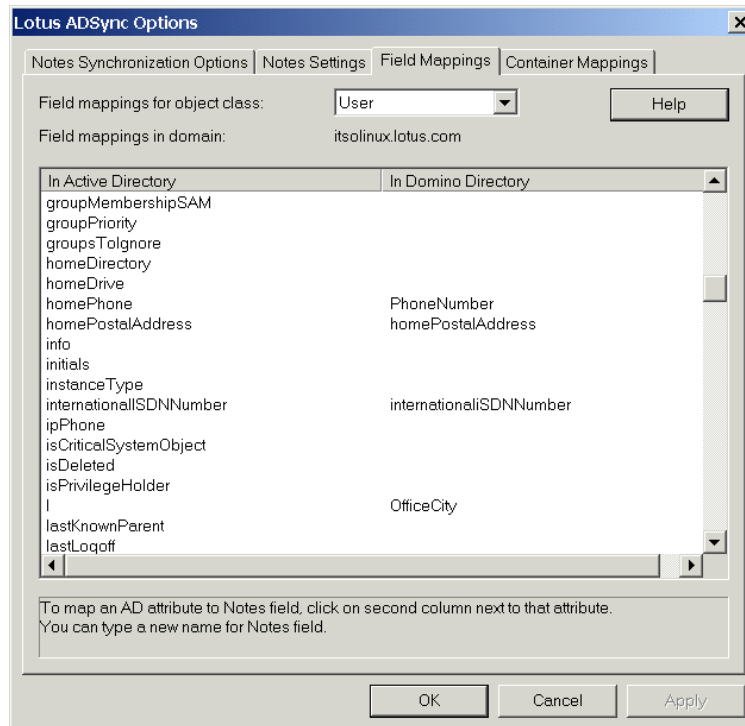


Figure 5-33 Lotus ADSync: Notes settings

On the Notes Settings tab you can specify:

- Registration server (which Domino server will be used for registration)
- Administration ID (which user ID will have administrative privileges)
- User deletion options (From the drop-down selection box, choose which actions should take place when a user is deleted.)
- Default certifier and policy
- Group type mappings



*Figure 5-34 Lotus ADSync: Field mappings*

The Field Mappings tab is where you select which Active Directory fields are to be mapped to Domino Directory fields. During ADSync tool initialization, the schemas from Active Directory and Domino are mapped based on default settings. If additional field mappings are needed, left-click in the right column under “In Domino Directory” and a drop-down selection box with Domino directory fields is presented.

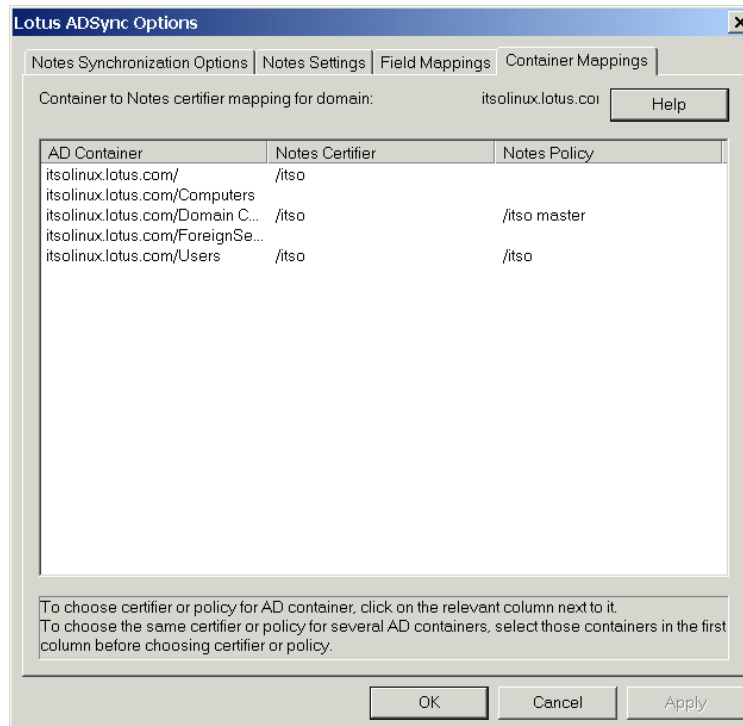


Figure 5-35 Lotus ADSync: Container mappings with Notes Certifier

The Container Mappings tab is where you can map Active Directory containers to Notes Certifiers and Policies. Active Directory containers are a special class that has both a namespace and attributes. The container does not represent anything real or concrete, but rather holds one or more objects. Objects, on the other hand, are the underlying principle of everything in the Active Directory. Servers, workstations, printers, users, documents, and devices all represent objects. Each object has its own access control list (ACL) and attributes.

By design, the synchronization tool allows you to preserve the hierarchies in Active Directory and Domino using mapping. You can select a specific container to map to a certifier and/or a policy. You may restrict access to a directory structure (container, object, and so forth) with group policies in Active Directory, just as you can use the extended access control list in Domino to issue restrictions. An extended ACL is an optional directory access control feature available for the Domino Directory, an Extended Directory Catalog, and the Administration Requests database.

**Note:** Refer to the Domino Administrator 6 Help document for additional information on setting up and managing extended access control lists.

The main point here is that a user can have certain rights in either directory and not the other. ADSync does not ensure that Active Directory group policies and Domino extended access control lists are synchronized. Therefore, the administrator is responsible for ensuring no security settings are bypassed in either directory.

In the lab, we selected the container root, the domain controllers, and the Users container. Beside the container you wish to associate with a certifier, double-click in the Notes Certifier column to see your selection choices. Select the appropriate certifier and click **OK** to continue.

### 5.2.3 Registering users in Domino from Active Directory

Now that your certifiers have been associated to your Active Directory containers, you can register users and groups. You have the ability to register existing Active Directory users and groups in Domino.

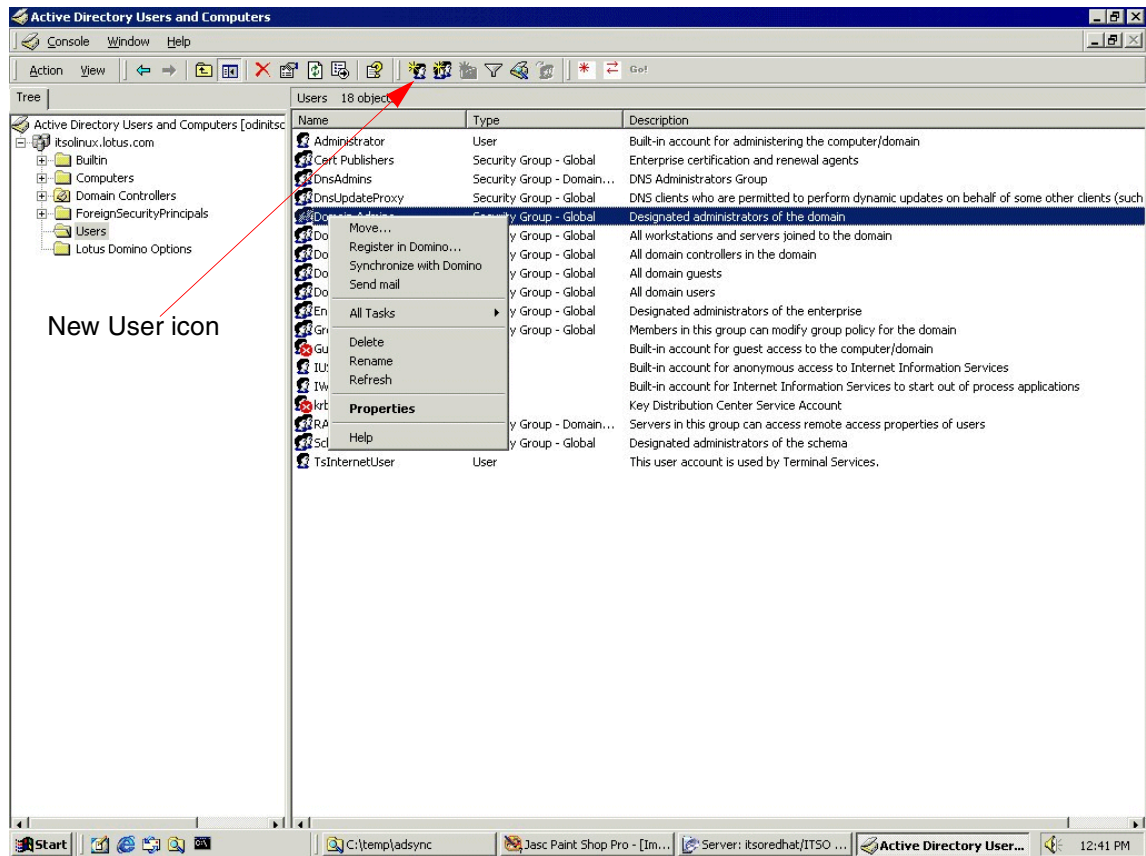


Figure 5-36 Active Directory Users and Groups: Register in Domino

To register users, select the appropriate container in the left-hand pane, then choose which user or group to register in the right-hand pane. Right-click the selected entry. A pop-up window is presented with Register in Domino as one of the options. This is shown in Figure 5-36.

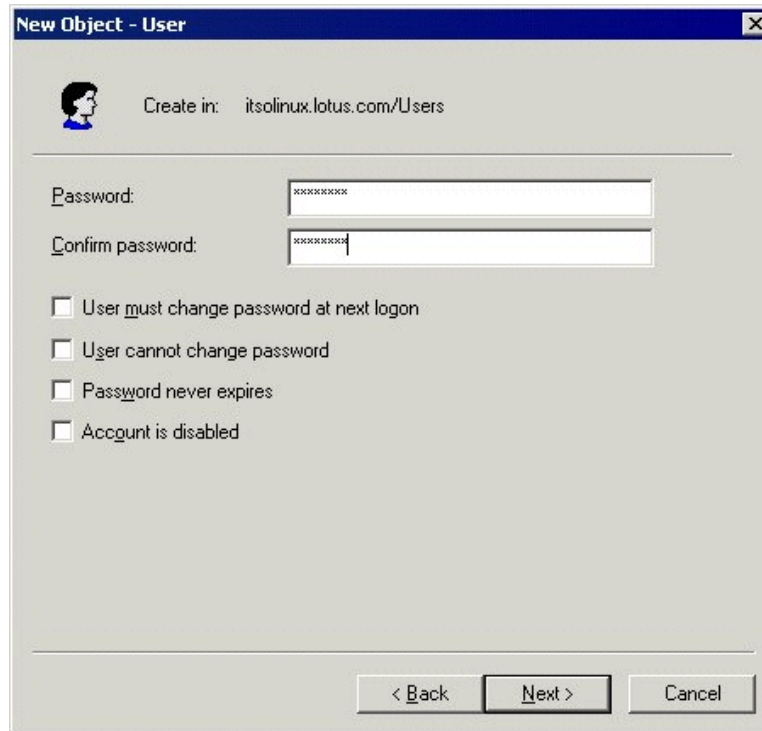
You can also create new users and groups in Active Directory and choose to register them in Domino at the same time. To illustrate this, we created a new user account in Active Directory by clicking the **New User** icon in the Active Directory toolbar (also shown in Figure 5-36). You can also use the Action drop-down menu for this option.



The screenshot shows a Windows-style dialog box titled "New Object - User". At the top, it says "Create in: itsolinux.lotus.com/Users". Below this, there are several input fields: "First name:" with "Joe", "Initials:" (empty), "Last name:" with "User", "Full name:" with "Joe User", "User logon name:" with "joe user" and a dropdown menu showing "@itsolinux.lotus.com", and "User logon name (pre-Windows 2000):" with "ITSOLINUX\" and "joe user". At the bottom, there are three buttons: "< Back", "Next >", and "Cancel".

*Figure 5-37 Active Directory New Object: User information*

The first window for New Object - User will be returned, as shown in Figure 5-37. After making entries in the appropriate fields, click **Next** to continue.



New Object - User

Create in: itsolinux.lotus.com/Users

Password: [password field]

Confirm password: [password field]

☐ User must change password at next logon

☐ User cannot change password

☐ Password never expires

☐ Account is disabled

< Back   Next >   Cancel

Figure 5-38 Active Directory New Object: User password

Enter the information for the password fields and click **Next** to continue. Base your choices for password expiration and modification, as well as disabled accounts, on your company's security policies.

Figure 5-39 Active Directory New Object - Domino information

In the window shown in Figure 5-39 you will notice an option to register this user or group in the Domino Directory. This window also provides fields for choosing the certifier context, an explicit policy, password fields for Domino, Notes short name, Internet address, and the ability to enable the use of common passwords. Once you have supplied the necessary information, click **Next** to continue.

The new user creation process then presents you with a summary of the user object you are about to create. Click **Finish** and the system will generate the Active Directory object, the new person document in the Domino Directory, a Lotus Notes ID file, and a user mail file.

That's it! You have successfully created a new user from within Active Directory and in doing so, you generated new objects for that person in both Domino and Windows 2000.

## 5.2.4 Registering users to Active Directory from Domino

In addition to registering users and groups from the Active Directory Users and Groups console for both the Windows 2000 and the Domino environments, you can register them from the Domino Administrator client.

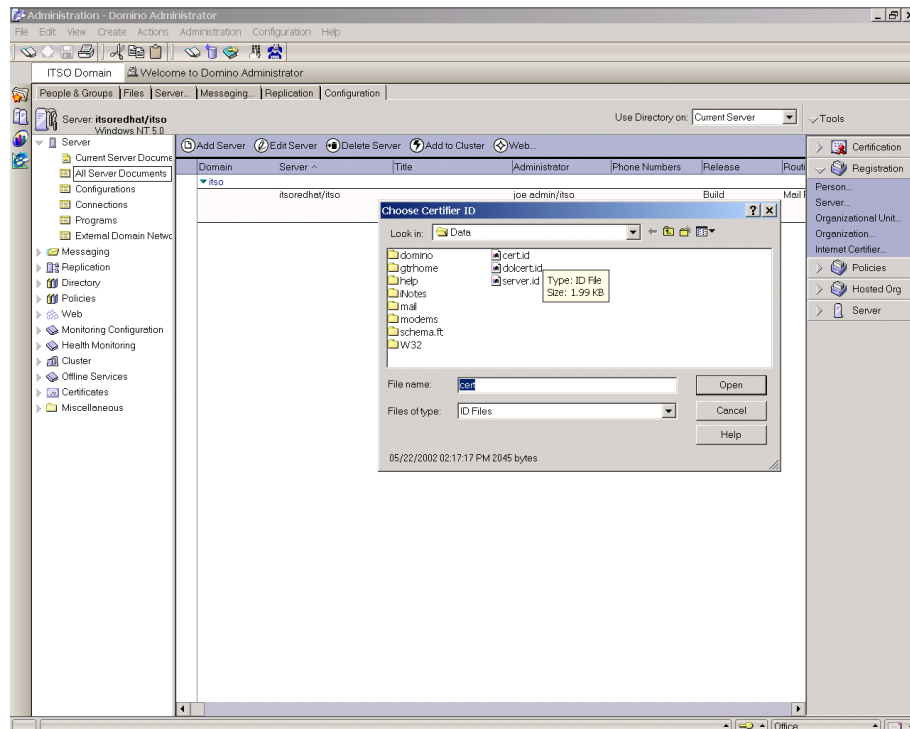


Figure 5-40 Domino Administration client: Choose certifier

Using the Domino Administration client, select the server to be used for registration and select the Configuration tab. On the right side of the screen, select **Tools -> Registration -> Person**. The Administration client then prompts you for the Notes Certifier ID file. Select the appropriate certifier file to be used, supply the certifier password and click **OK**.

Register Person -- billy boykin

Provide name, password and other basic information for the new person. To view/edit additional registration settings, check the 'Advanced' checkbox below.

Registration Server: itsoredhat/itso

First name: billy Middle name: Last name: boykin Short name: bboykin

Password: Password Options... Mail system: iNotes Explicit policy: /itso master

No organization policy assigned to this person

Policy Synopsis...

☐ Let this person roam

☒ Create a Notes ID for this person

☐ Advanced

New Person Migrate People... Import Text File...

Registration Queue (local):

User Name	Registration Status	Date

Register All Register Delete Options... Views... Done

Figure 5-41 Domino Administration client: Register Person screen

The Domino Administration client then presents you with a Register Person window. Complete the registration fields in this window, then click the check box for Advanced options.

**Register Person -- billy boykin**

**Basics**  
**Mail**  
**Address**  
**ID Info**  
**Groups**  
**Roaming**  
**Other**

Setup profile: [None Available] Unique org unit: [ ] Location: [ ]

Local administrator: [ ] Comment: [ ]

Choose an alternate name language to enable alternate name and org unit

Alternate name language: [None] Alternate name: [ ] Alternate org unit: [ ]

Windows User Options...

☒ Advanced New Person Migrate People... Import Text File... [ ] [ ]

Registration Queue (local):

User Name ^	Registration Status ^	Date ^

Register All Register Delete Options... Views... Done

Figure 5-42 Domino Administration Client - Register Person (Advanced)

Complete the information appropriate for your organization in the Mail, Address, ID Info, Groups, and Roaming sections. Click the tab for the Other section; click the **Windows User Options** button to add this person to Windows 2000.

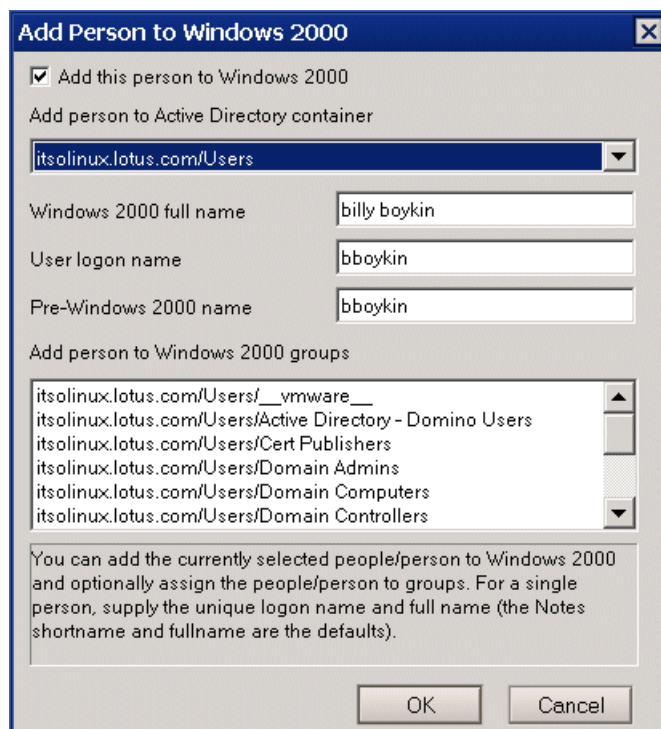


Figure 5-43 Domino: Add Person to Windows 2000

In this window, select the Active Directory container and Windows 2000 groups to add this person to, then click **OK** when finished. This particular account was placed in the Users container. We could have placed the user in any container appropriate for that account's security rights.

**Register Person -- New Entry**

**Basics**

Setup profile: (None Available) Unique org unit: Location:

Local administrator: Comment:

Choose an alternate name language to enable alternate name and org unit

Alternate name language: (None) Alternate name: Alternate org unit:

Preferred language: (None)

Windows User Options... billy boykin

☒ Advanced New Person Migrate People... Import Text File...

Registration Queue (local):

^ User Name ^	^ Registration Status ^	Date ^

Register All Register Delete Options... Views... Done

Figure 5-44 Domino Administration client: Confirm person registration

Click the check mark box in the Register Person window to confirm you have finished entering all necessary data for this person. This box is located on the right-hand side of the Register Person window and is circled in Figure 5-44.



Register Person -- billy boykin

Basics | Mail | Address | ID Info | Groups | Roaming | Other

Setup profile: (None Available) Unique org unit: Location:

Local administrator: Comment:

Choose an alternate name language to enable alternate name and org unit

Alternate name language: (None) Alternate name: Alternate org unit:

Preferred language: (None)

Windows User Options...

Advanced ☒ New Person Migrate People... Import Text File...

Registration Queue (local):

^ User Name ^	^ Registration Status ^	Date ^
boykin, billy	Ready for registration	05/29/2002

Register All Register Delete Options... Views... Done

Figure 5-45 Domino Administration client: Register person

The entry will then be added to the Registration Queue window at the bottom of the screen. Click **Register** to initiate the registration process.

Once the registration process completes, this person will exist in both the Domino Directory and Active Directory.

## 5.3 Accessing external data from Domino: DB2 example

This section describes how to use Domino Enterprise Connection Services (DECS) to enable a Domino application to access data from the DB2 sample database. It includes the following topics:

- ▶ Installing DB2 for Linux
- ▶ Domino Enterprise Connection Services
- ▶ Virtual field activities
- ▶ Creating the Domino application
- ▶ Testing the Domino application

### 5.3.1 Installing DB2 for Linux

This section provides detailed instructions for installing, configuring, and verifying IBM DB2 Universal Database V7.2.1, Enterprise Edition for Linux.

#### Prerequisite Linux packages for DB2

The DB2 product documentation should be consulted for the official list of prerequisite software. After installing Red Hat Linux V7.2 we found that the only missing package needed was ncurses4. Depending on the Linux options chosen, the latest version of this package may be installed when initially installing Linux. You may also install ncursesvX later using one of the RPM package tools. Our search for this package resulted in a later version of ncurses, v5, which we installed. Version 4 is a minimum requirement for the release of DB2 we used.

To see if you have ncurses5 on your system, you can do the following:

1. Verify whether the package is installed on the system using:

```
rpm --verify ncurses5.2-12
```

2. If no output is generated, the package is installed correctly; otherwise, the rpm package manager will return an error similar to the following:

```
Package ncurses5.2-12 is not installed
```

If the package is not installed, you must locate and install it before proceeding with the DB2 installation. There are a number of ways to do this. The easiest way to install the package is from the original Red Hat Linux V7.2 CD; otherwise, you can locate and download it from the Web.

Insert the second Red Hat Linux 7.2 CD into the CD-ROM drive (the ncurses4 package exists on that CD).

If the CD doesn't automatically mount (it may if you're running X Windows with either the KDE or Gnome desktops) it can manually be mounted by issuing the following command as root:

```
mount /mnt/CD-ROM
```

This should work for a default installation. If it fails, verify the device that represents your CD-ROM drive and issue the following command instead:

```
mount -r /dev/<device> /mnt/cdrom
```

For instance, on our system, the CD-ROM drive is the first device on the second IDE channel. Thus it is (in Linux) referred to as *hdc* and can be mounted by the following command:

```
mount -r /dev/hdc /mnt/cdrom
```

If you do not have the CD, then find the ncurses4 RPM on the Web. Go to <http://rpmfind.net/> and enter ncurses4 into the search box. Click Search, and download the RPM.

Alternatively, you can find it in the directories of the Red Hat Linux FTP site at:

```
ftp://ftp.redhat.com
```

Once you have the RPM file either mounted or saved somewhere on your system, use the following command to install or upgrade the package:

```
rpm -U --nodeps <path to file>/ncurses5.2-12.i386.rpm
```


For example, from the product CD:

```
rpm -U --nodeps /mnt/cdrom/RedHat/RPMS/ncurses5.2-12.i386.rpm
```

DB2 for Linux also requires the pdksh 5.2.14-12 package. When installing Red Hat 7.2 Linux this will likely be installed by default, depending on the options selected during the installation. Enter the following command to determine if pdksh was installed:

```
rpm -qa |grep pdksh-5.2.14-12.i386.rpm
```

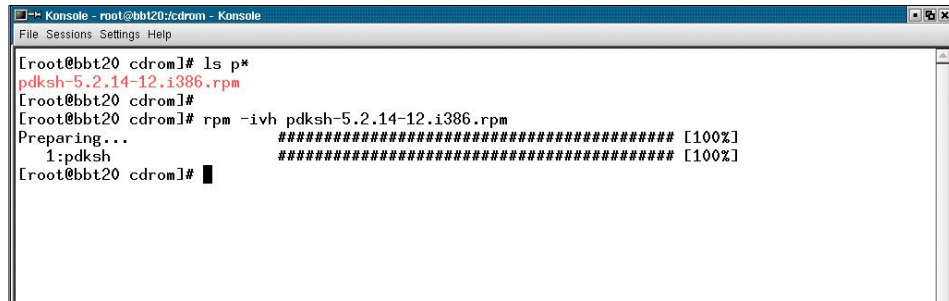
If the package is not installed the Linux command prompt will return with no information.

A terminal window titled 'Konsole - root@bbt20:/cdrom - Konsole' with a menu bar (File, Sessions, Settings, Help). The terminal shows the following commands and output:

```
[root@bbt20 cdrom]# ls p*
pdksh-5.2.14-12.i386.rpm
[root@bbt20 cdrom]#
[root@bbt20 cdrom]# rpm -ivh pdksh-5.2.14-12.i386.rpm
```

Figure 5-46 DB2 preinstall steps: rpm pdksh

In the event you selected the custom installation, it is possible that your selections will not include the pdksh package. In this scenario, obtain the package from either the CD or the Web using the steps outlined previously and use the command shown in Figure 5-46 to install the package. Our command assumes the package is installed from the CD.

A terminal window titled 'Konsole - root@bbt20:/cdrom - Konsole' with a menu bar (File, Sessions, Settings, Help). The terminal shows the same commands as Figure 5-46, but with additional output for the rpm command:

```
[root@bbt20 cdrom]# ls p*
pdksh-5.2.14-12.i386.rpm
[root@bbt20 cdrom]#
[root@bbt20 cdrom]# rpm -ivh pdksh-5.2.14-12.i386.rpm
Preparing...                               [100%]
 1:pdksh                                   [100%]
[root@bbt20 cdrom]#
```

Figure 5-47 DB2 preinstall steps - rpm pdksh installation complete

When the installation completes your screen should look like Figure 5-47.

## Preinstallation tasks

Prior to installing IBM DB2 Universal Database V7.2.1, Enterprise Edition, the following checks need to be completed.

Verify that there are no existing active services that use the same DB2 TCP/IP ports on the server:

- 523 (DB2 Server)
- 50000 (default DB2 instance connection port)
- 50001 (default DB2 instance interrupt port)
- 50002 (DB2 Control Server)

We suggest using the following command for this task:

```
netstat -an |grep LISTEN
```

**Note:** Netstat is a Linux tool for printing network connection and routing information, and network statistics. Refer to the Linux documentation for your operating environment for additional information.

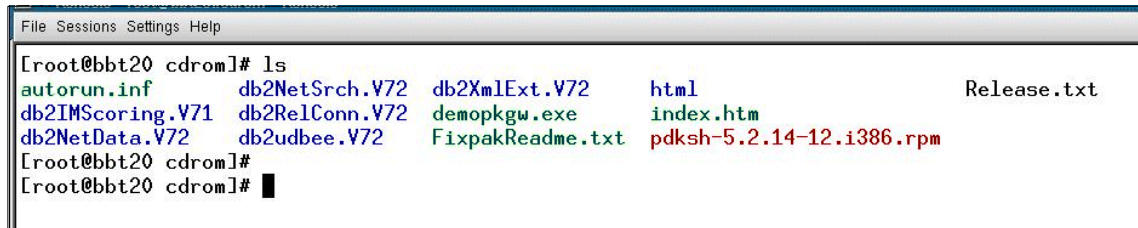
If you find Linux services running on the ports, refer to Linux documentation for information on disabling them.

## Install the DB2 Server

In order to install IBM DB2 Universal Database V7.2, Enterprise Edition for Linux, perform the following steps:

1. Log in as root and start a terminal session
2. Mount the DB2 V7.2 CD-ROM with:

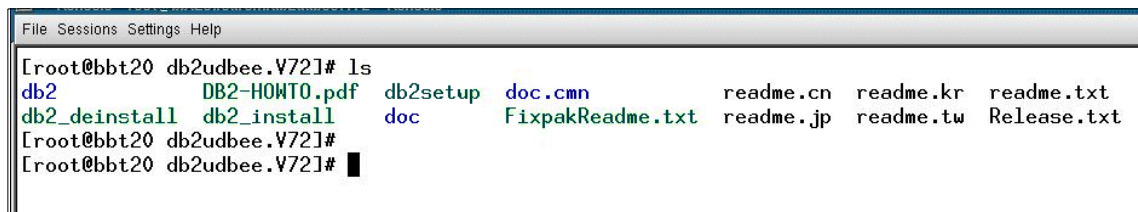
```
mount /mnt/cdrom
```



```
File Sessions Settings Help
[root@bbt20 cdrom]# ls
autorun.inf      db2NetSrch.V72  db2Xm1Ext.V72  html           Release.txt
db2IMScoring.V71 db2RelConn.V72 demopkgw.exe   index.htm
db2NetData.V72  db2udbee.V72   FixpakReadme.txt pdksh-5.2.14-12.i386.rpm
[root@bbt20 cdrom]#
[root@bbt20 cdrom]#
```

Figure 5-48 DB2 v7.2 CDROM Contents

3. List the contents of the root directory on the CD-ROM with the **ls** command (Figure 5-48).



```
File Sessions Settings Help
[root@bbt20 db2udbee.V72]# ls
db2          DB2-HOWTO.pdf  db2setup  doc.cmh        readme.cn  readme.kr  readme.txt
db2_deinstall db2_install    doc       FixpakReadme.txt readme.jp  readme.tw  Release.txt
[root@bbt20 db2udbee.V72]#
[root@bbt20 db2udbee.V72]#
```

Figure 5-49 DB2 v7.2 CDROM: db2setup script

4. Navigate to the appropriate directory on the CD-ROM for the version of DB2 you are installing.

Enter the following command to start the DB2 installation script:

```
./db2setup
```

This setup script should present the Install DB2 V7 window shown in Figure 5-50 on page 292.

**Note:** To navigate within the DB2 installation program, use the Tab key to move between options and fields. Highlight options and fields with the Spacebar and press Enter to select an option. Also, you can refresh the window at any time by pressing CTRL+L.

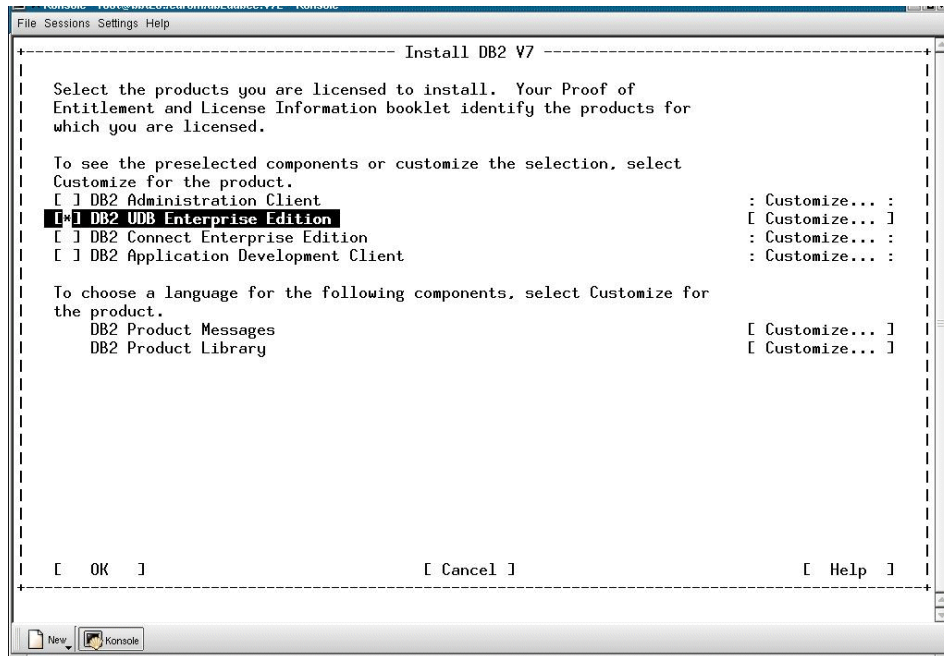


Figure 5-50 DB2 v7.2 - Enterprise Edition installation

5. Select the DB2 UDB Enterprise Edition.

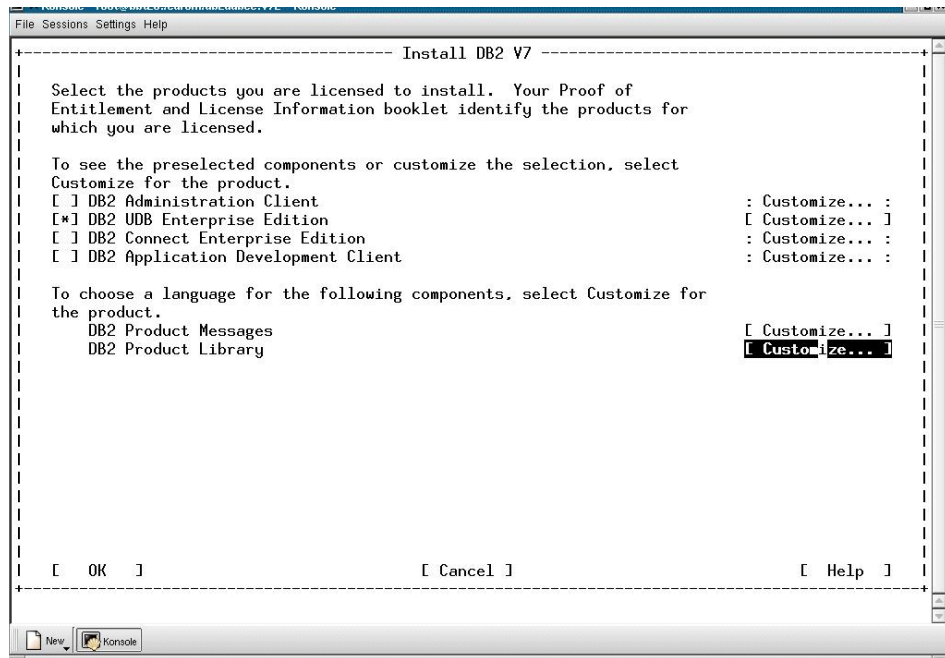


Figure 5-51 DB2 v7.2: Customize Product Library

6. Highlight the DB2 Product Library's **Customize** option and press Enter.

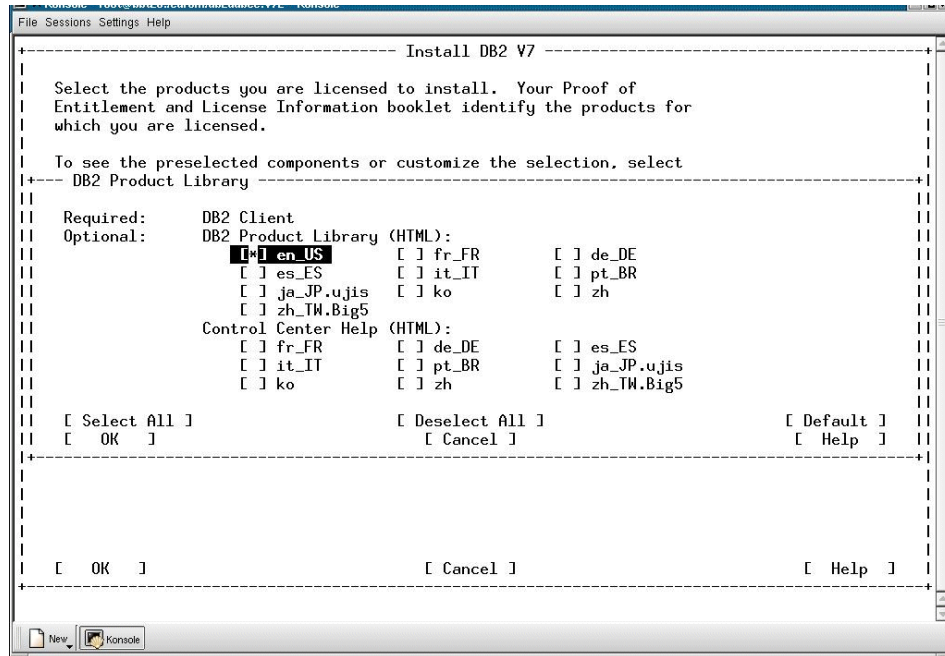


Figure 5-52 DB2 v7.2: Language selection

7. In the DB2 Product Library window, highlight the appropriate option for locale under the HTML section, then highlight **OK** and press Enter.



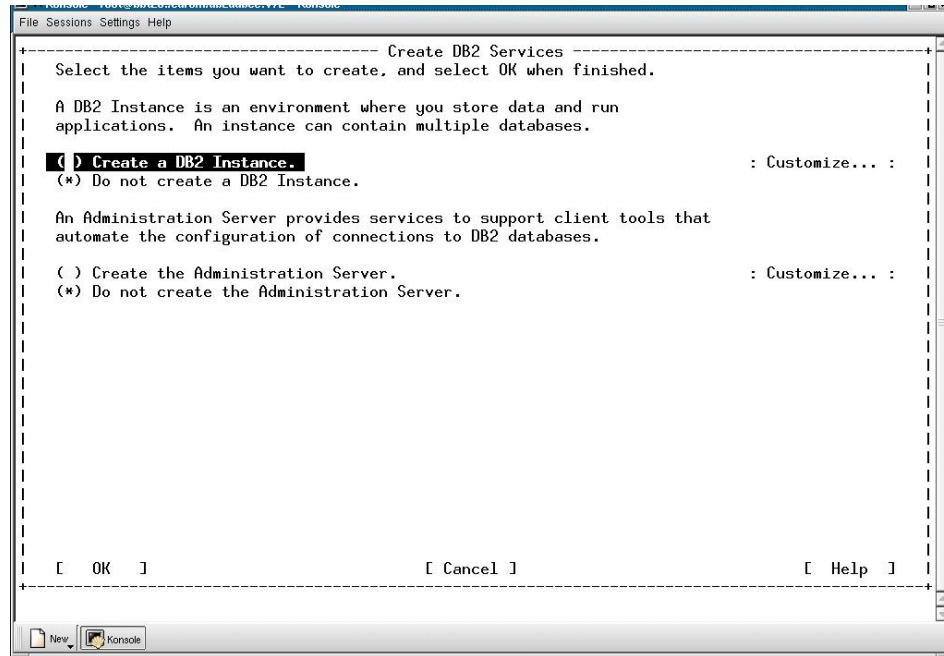


Figure 5-53 DB2 v7.2: Create DB2 instance

8. In the Create DB2 Services window select the **Create a DB2 Instance** option, highlight **OK** and press Enter.

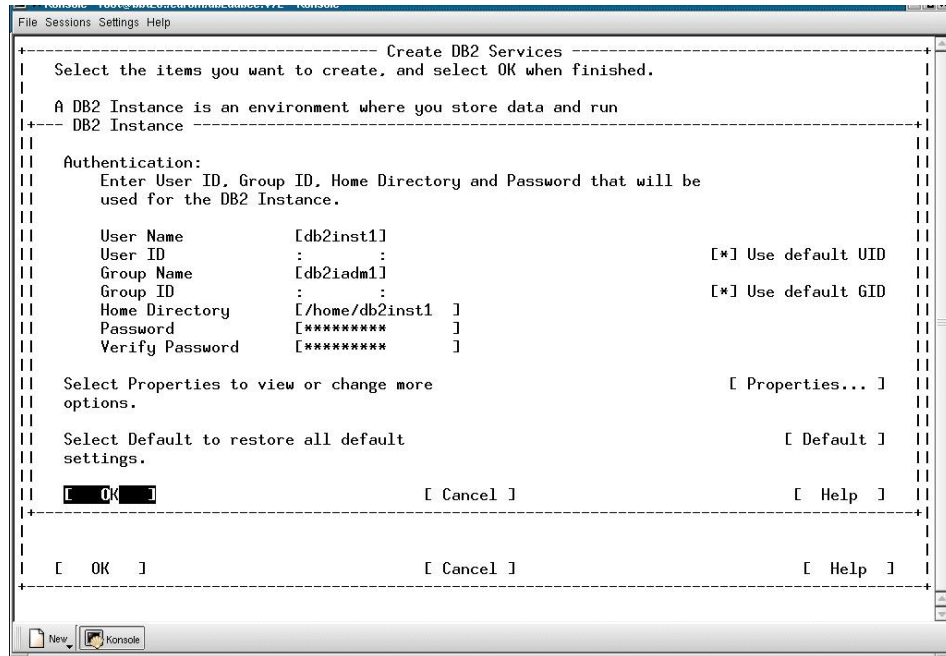


Figure 5-54 DB2 v7.2: DB2 instance owner ID

9. When the DB2 instance authentication window appears, accept the default values, supply a password for the **Password** and **Verify Password** fields, highlight **OK**, and press Enter.

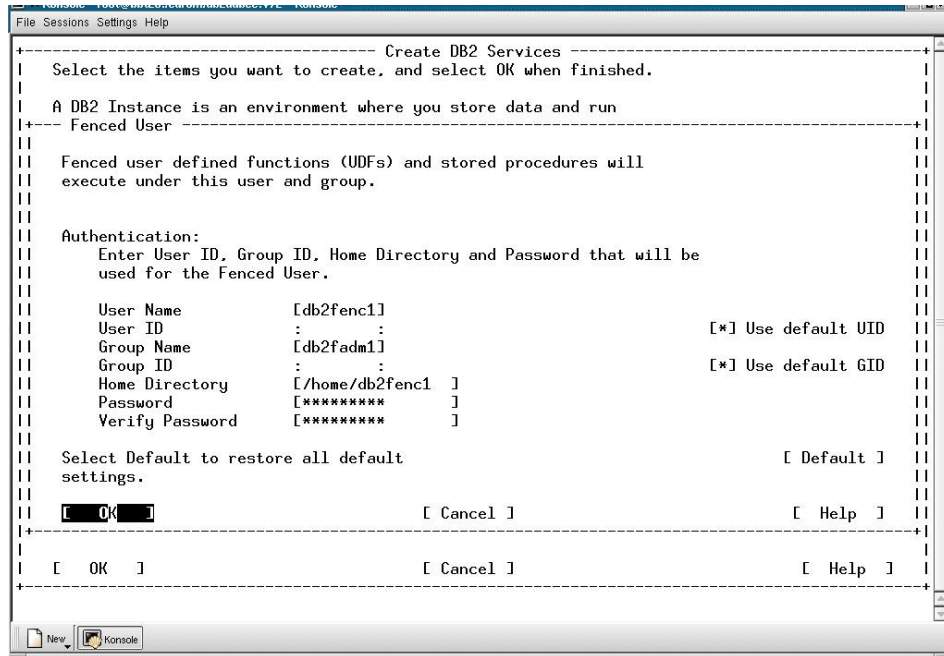


Figure 5-55 DB2 v7.2: Fenced User ID

10. When the DB2 Fenced User window appears, accept the default values, supply a password for the **Password** and **Verify Password** fields, highlight **OK** and press Enter.

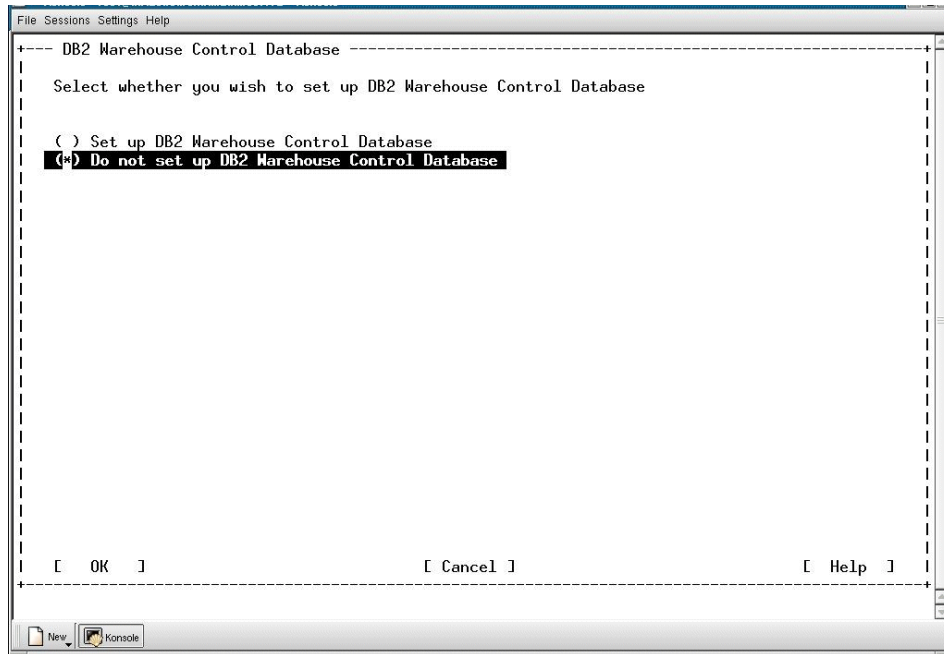


Figure 5-56 DB2 v7.2: Warehouse control database

11. In the DB2 Warehouse Control Database window, *deselect* the **Setup DB2 Warehouse Control Database** option, highlight **OK** and press Enter.

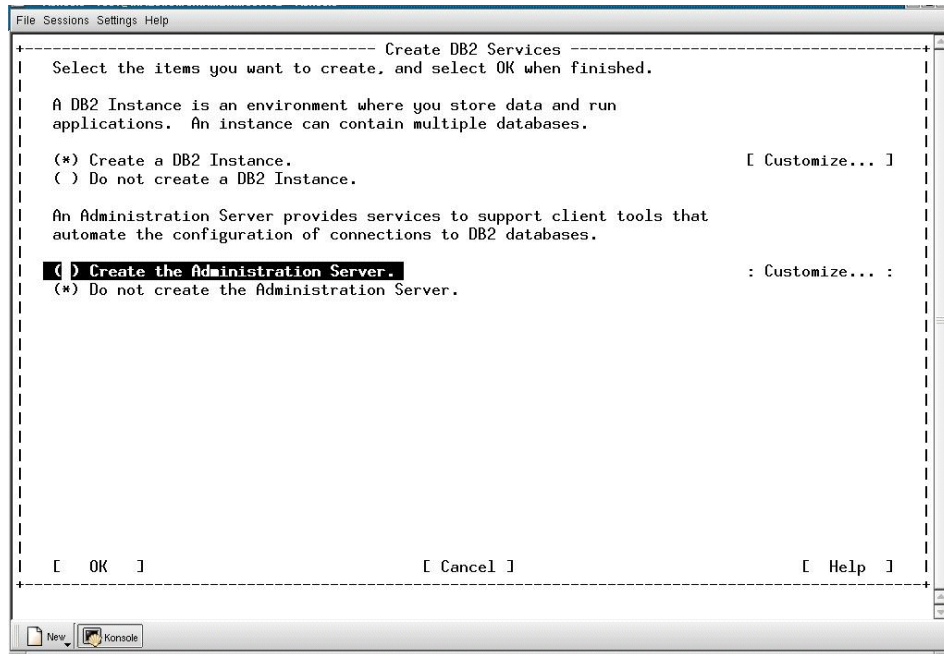


Figure 5-57 DB2 v7.2: Administration server

12. In the Create DB2 Services window highlight the **Create Administration Server** option, highlight **OK** and press Enter.

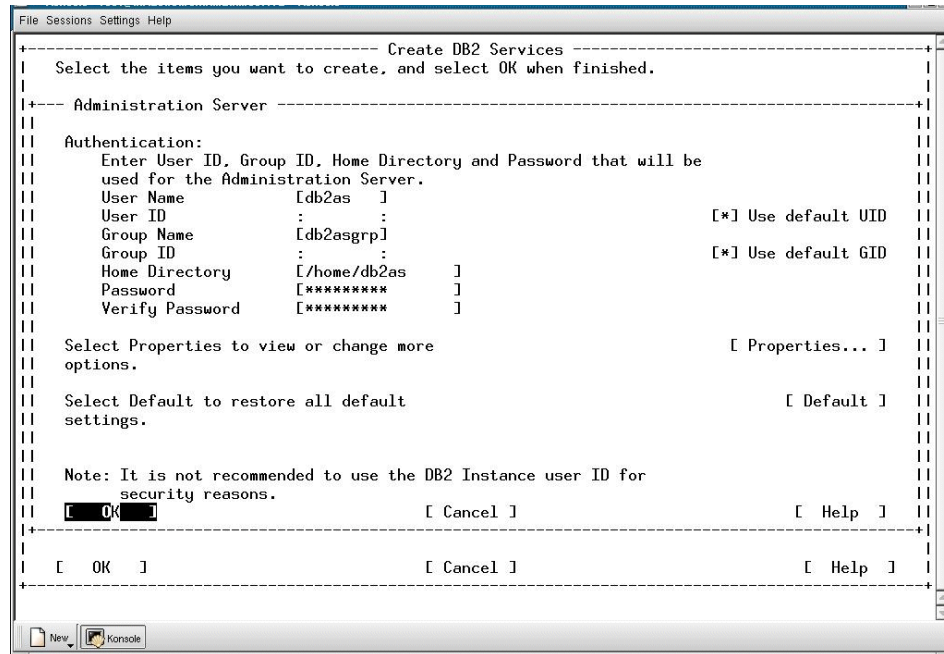


Figure 5-58 DB2 v7.2: Administration server user ID

13. In the Administration server window accept the default values, supply a password for the **Password** and **Verify Password** fields, highlight **OK** and press Enter.

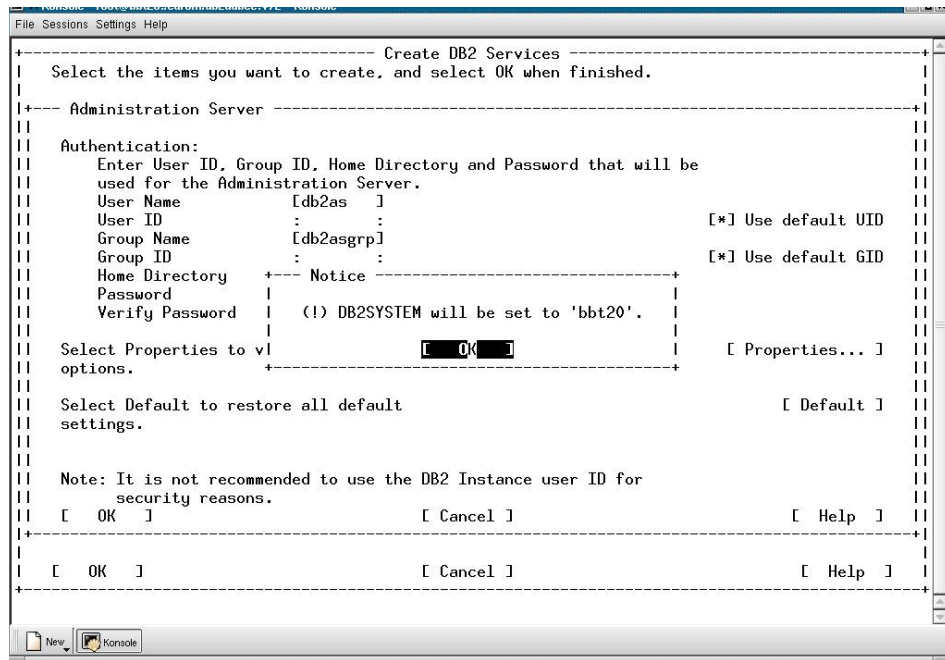


Figure 5-59 DB2 v7.2: DB2System name

14. A message window appears to indicate that DB2SYSTEM will be set to *hostname*. Highlight **OK**, then press Enter.

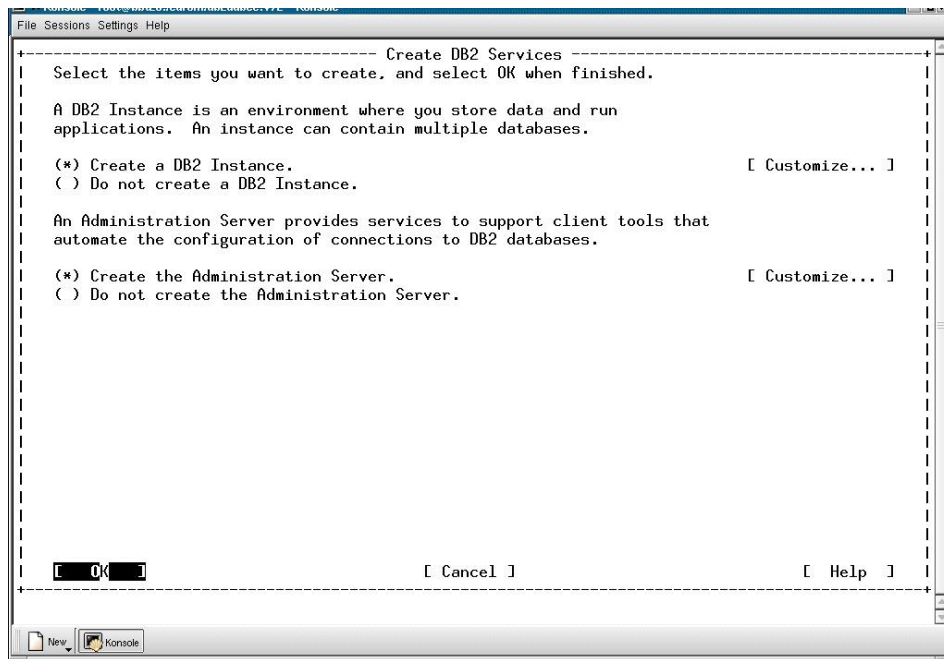


Figure 5-60 DB2 v7.2: Create services

15. In the Create DB2 Services window highlight **OK** and press Enter.



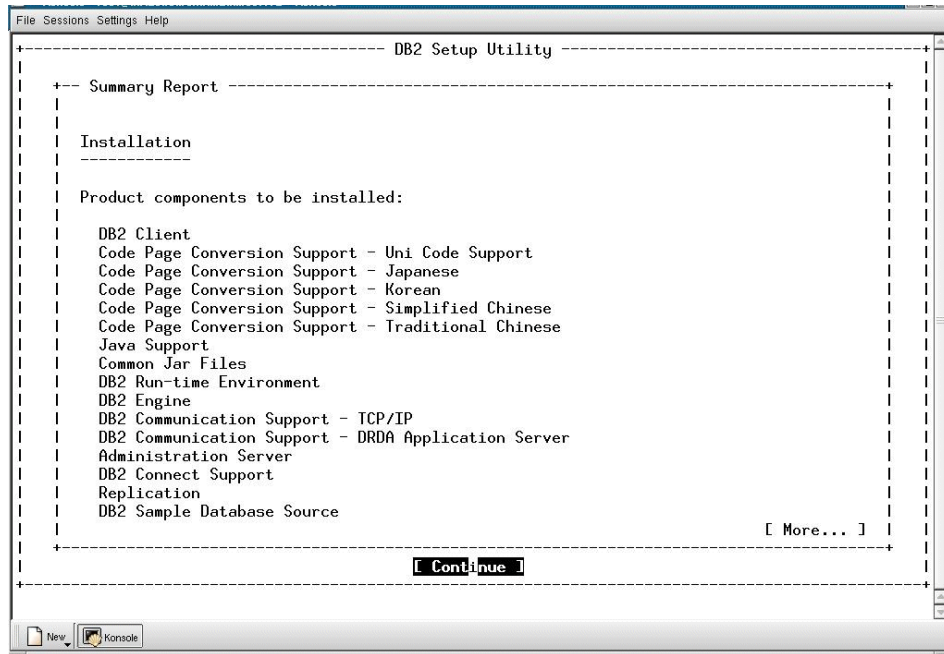


Figure 5-61 DB2 v7.2: Setup summary

16. At this point the DB2 V7 installation displays a summary report listing the product components you selected to be installed. Highlight **Continue** and press Enter.

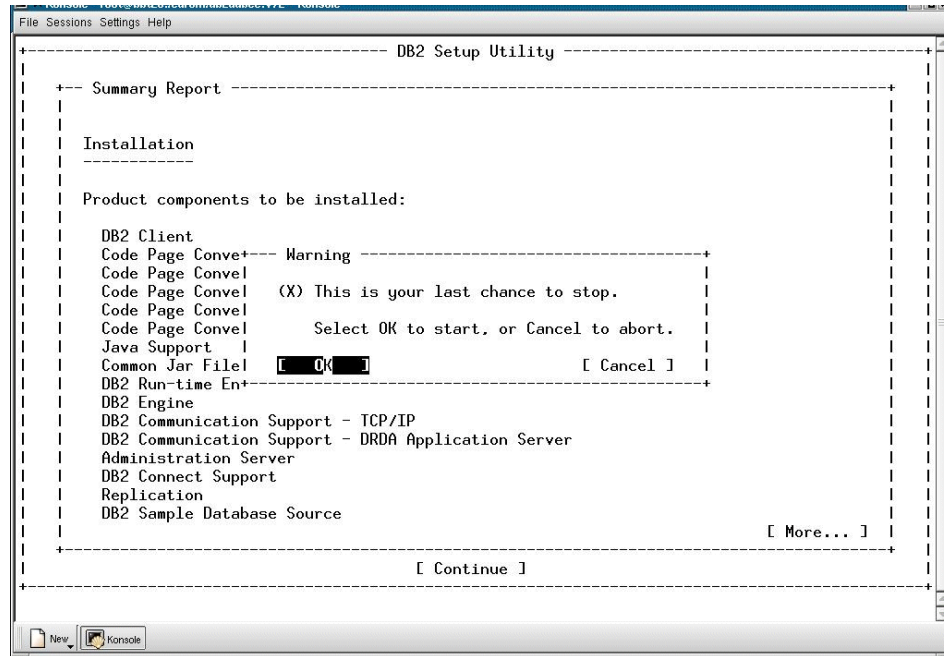


Figure 5-62 DB2 v7.2: Setup confirmation

17. Next a warning window appears stating “This is your last chance to stop.” Highlight **OK** to continue, and press Enter.
18. The DB2 setup program installs the selected components. Depending on the speed of your computer, this may take up to 15 minutes. You may be prompted to register the product. If so, complete the registration information then exit back to the installation window. When the installation is complete, a window informs you if the installation was successful. Highlight **OK** and press Enter.
19. A Status Report of the installation is then displayed. Review the report to ensure all of your selected components were installed, highlight **OK** and press Enter.
20. The DB2 V7 installation windows appears. Highlight **Close** and press Enter.
21. A window appears prompting “Do you want to exit the DB2 Installer?” Highlight **OK** and press Enter.
22. Unmount the CD-ROM with the following commands:

```
cd /
umount /mnt/cdrom
```

The DB2 installation is now complete.

### Verify the DB2 Server installation

To verify the DB2 Server installation, complete the following tasks:

- ▶ Verify home directory permissions
- ▶ Verify the DB2 instance owner profile
- ▶ Verify the DB2 instance symbolic links
- ▶ Verify the DB2 release level
- ▶ Verify the DB2 service name
- ▶ Verify the database manager configuration
- ▶ Create the DB2 sample database

#### Verify home directory permissions

Check that the home directory ownership has been correctly set up by the DB2 installation program. Using Table 5-2 for reference, log in as root, start a terminal session and navigate to /home directory. Use the following command to confirm directory ownership and permissions.

```
ls -la
```

Table 5-2 Home directory permissions

Home directory path	Owner	Group	Permissions
/home/db2inst1	db2inst1	db2iadm1	drwxr-xr-x
/home/db2fenc1	db2fenc1	db2fadm1	drwxr-xr-x
/home/db2as	db2as	db2asgrp	drwxr-xr-r
Permissions needed so that the DB2 instance owner can read, write, and execute files and directories within the path. Group members' and other users' access rights are determined by your company's security policies and business requirements.			

If one of the DB2 home directories is not configured properly, issue the following command in the appropriate directory. You should be logged in as root. Substitute values from Table 5-2 as appropriate.

```
chown -fR owner:group home-directory-path
```

#### Verify the DB2 instance owner profile

The DB2 server installation should modify the .bashrc environment file of the instance owner so that environment will be set up when the DB2 instance user logs in. The .bashrc file is located in the home directory. If you accepted the default field values during the installation, that directory will be /home/db2inst1

Since this file is hidden, use the following command to confirm its existence in the directory:

```
ls -la
```

Use the **more** **.bashrc** command to display the contents of the **.bashrc** and confirm the following lines have been added. If the following lines are not present, use your favorite text editor to manually add them.

```
if [ -f /home/db2inst1/sqllib/db2profile ] ; then
. /home/db2inst1/sqllib/db2profile
fi
```

### ***Verify the DB2 instance symbolic links***

The DB2 Server installation automatically creates a DB2 instance (db2inst1) under the /home/db2inst1 directory. Included in the instance creation process, the DB2 installation program creates symbolic links in the /home/db2inst1/sqllib directory to files under /usr/IBMDB2/V7.1.

**Note:** Although the DB2 installation CDROM, documentation, and installation screens refer to the version as 7.2, we found the actual directory created by the setup script was named V7.1

To confirm their existence, log in as root and start a terminal session. Navigate to the /home/db2inst1/sqllib directory and issue the following command:

```
ls -la
```

If the symbolic links have been created, your output from this command should resemble the screen shown in Figure 5-63.

```

File Sessions Settings Help
lrwxrwxrwx 1 root db2iadm1 21 Apr 22 11:26 conv -> /usr/IBMDb2/V7.1/conv
drwxrwsr-t 2 db2inst1 db2iadm1 4096 Apr 22 11:26 ctrl
-rwxr-xr-x 1 db2inst1 db2iadm1 4489 Apr 22 11:26 db2cshrc
drwxrwsr-t 2 db2inst1 db2iadm1 4096 Apr 22 11:26 db2dump
-rwxr-xr-x 1 db2inst1 db2iadm1 4302 Apr 22 11:26 db2profile
-rw-rw-r-- 1 db2inst1 db2iadm1 4096 Apr 22 11:26 db2system
lrwxrwxrwx 1 root db2iadm1 20 Apr 22 11:26 doc -> /usr/IBMDb2/V7.1/doc
lrwxrwxrwx 1 root db2iadm1 33 Apr 22 11:26 doc.cmn -> /home/db2inst1/sqllib/doc/doc.cmn
n
lrwxrwxrwx 1 db2inst1 db2iadm1 1 Apr 22 11:26 .ftok -> .
drwxrwsr-t 3 db2inst1 db2iadm1 4096 Apr 22 11:26 function
lrwxrwxrwx 1 root db2iadm1 24 Apr 22 11:26 include -> /usr/IBMDb2/V7.1/include
lrwxrwxrwx 1 root db2iadm1 21 Apr 22 11:26 java -> /usr/IBMDb2/V7.1/java
lrwxrwxrwx 1 root db2iadm1 23 Apr 22 11:26 java12 -> /usr/IBMDb2/V7.1/java12
lrwxrwxrwx 1 root db2iadm1 20 Apr 22 11:26 lib -> /usr/IBMDb2/V7.1/lib
drwxrwsr-t 2 db2inst1 db2iadm1 4096 Apr 22 11:26 log
lrwxrwxrwx 1 root db2iadm1 20 Apr 22 11:26 map -> /usr/IBMDb2/V7.1/map
lrwxrwxrwx 1 root db2iadm1 21 Apr 22 11:26 misc -> /usr/IBMDb2/V7.1/misc
lrwxrwxrwx 1 root db2iadm1 20 Apr 22 11:26 msg -> /usr/IBMDb2/V7.1/msg
drwxrwxr-x 2 db2inst1 db2iadm1 4096 Apr 22 11:26 .netls
-rw-rw-r-- 1 db2inst1 db2iadm1 36 Apr 22 11:26 profile.env
lrwxrwxrwx 1 root db2iadm1 19 Apr 22 11:26 qp -> /usr/IBMDb2/V7.1/qp
lrwxrwxrwx 1 root db2iadm1 23 Apr 22 11:26 Readme -> /usr/IBMDb2/V7.1/Readme
lrwxrwxrwx 1 root db2iadm1 24 Apr 22 11:26 samples -> /usr/IBMDb2/V7.1/samples
drwxr-xr-x 2 db2inst1 db2iadm1 4096 Apr 22 11:26 security
drwxr-xr-x 3 db2inst1 db2iadm1 4096 Apr 22 11:26 spb
drwxrwsr-x 2 db2inst1 db2iadm1 4096 Apr 22 14:51 sqldbdir
drwxrwsrwx 2 db2inst1 db2iadm1 4096 Apr 22 16:54 tmp
-rwxr-xr-x 1 db2inst1 db2iadm1 0 Apr 22 11:26 usercshrc
-rwxr-xr-x 1 db2inst1 db2iadm1 0 Apr 22 11:26 userprofile
[db2inst1@itsoredhat sqllib]$

```

Figure 5-63 DB2 v7.2 - Display symbolic links

If for some reason these links do not appear, navigate to the /usr/IBMDb2/V7.1 directory and issue the following script to generate the symbolic links:

```
./db2ln
```

### Verify the DB2 release level

Check the release level of the DB2 Server program you just installed with the following commands:

```
su - db2inst1
db2level
```

This should generate output similar to the screen shown in Figure 5-64.

```

File Sessions Settings Help

[db2inst1@itsoredhat db2inst1]$ db2level
DB21085I Instance "db2inst1" uses DB2 code release "SQL07020" with level
identifier "03010105" and informational tokens "DB2 v7.1.0.40", "s010415" and
"U475381".

[db2inst1@itsoredhat db2inst1]$

```

Figure 5-64 DB2 v7.2 - DB2level

### **Verify the DB2 service name**

Log in as root and view the /etc/services file. This can be accomplished by either navigating to the /etc directory and issuing **more services** or from the root login prompt issuing the following command:

```
more /etc/services
```

Locate the service name in the first column that corresponds to the port numbers used by DB2. Specifically, the lower port (50000) represents the service name. These recent additions to the services file should be located near the bottom and look like this:

```
db2cdb2inst1 50000/tcp #Connection port for DB2 instance db2inst1
db2idb2inst1 50001/tcp #Connection port for DB2 instance db2inst1
```

Record this service name (db2cdb2inst1) for use later.

### **Verify the database manager configuration**

Check the service name recorded in the database manager configuration by performing the following commands:

```
su - db2inst1
db2 get dbm cfg | grep SVCENAME
```

The service name value should match the service name recorded in the /etc/services file noted previously. The results of the **grep** command should resemble Figure 5-65.

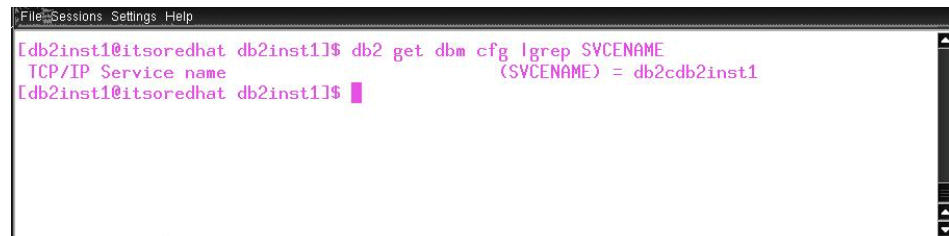


Figure 5-65 DB2 v7.2 - DB2 Service Name

If the service name values do not match, issue the following commands to update the database manager configuration where *svcname* represent the value found in the /etc/services file.

```
db2 update dbm cfg using svcname db2cd
db2stop
db2start
```

### Create the DB2 sample database

The DB2 installation can be tested by creating and connecting to the sample database supplied with the product specifically for this purpose. This can be done with following commands.

```
su - db2inst1
db2samp1
db2 list db directory
```

The results of the **list db** command should resemble Figure 5-66.



```
File Sessions Settings Help
[db2inst1@itsoredhat db2inst1]$ db2 list db directory

System Database Directory

Number of entries in the directory = 1

Database 1 entry:

Database alias           = SAMPLE
Database name           = SAMPLE
Local database directory = /home/db2inst1
Database release level   = 9.00
Comment                  =
Directory entry type     = Indirect
Catalog node number     = 0

[db2inst1@itsoredhat db2inst1]$
```

Figure 5-66 DB2 v7.2 - DB2 db directory

To ensure access to the database, issue the following commands to test connectivity. If you do not receive error messages, you have successfully created the sample database.

```
db2 connect to sample
db2 disconnect current
```

### Starting and stopping the DB2 server

After DB2 server installation, the DB2 server should be running and configured to restart itself at boot time. You can use the following commands to manually stop and start the DB2 server. If the server is already running when you enter a start command, the system will display a message indicating the DB2 server is already running.

```
su - db2inst1 "-c db2stop"
su -db2as "-c db2stop"
su -db2as "-c db2start"
su -db2inst1 "-c db2start"
```

### 5.3.2 Accessing external data from a Domino application

The release of DECS that ships with Domino 6 Enterprise Server replaces RealTime Activities with Virtual Fields Activities. Virtual Fields Activities include all the functionality available in the earlier DECS RealTime activity, along with a number of new features, including:

- Support for computed subforms
- Options for new line delimiters
- An additional logging option
- Support for procedure return parameters following insert and update operations

Output from write operations allows results to be returned to fields in the Notes document being monitored following insert and update operations.

**Note:** Refer to the *Domino Enterprise Connection Services User Guide* for additional information about DECS and Virtual Fields.

### 5.3.3 Virtual Fields Activity

Virtual Fields Activities (previously known as DECS RealTime Activities) enhance Lotus Notes applications by enabling them to retrieve external data, such as data from DB2, and to integrate this external data with native Notes data on a single Notes document form. DECS, running on the Domino Server that is hosting the Domino application, intercepts and handles the Domino database events. For example, when Notes or Web client users open, create, update, or save Notes documents, these events are acted upon, obtaining immediate access from the Notes form to external data sources supported by DECS. You get the data immediately (dependent, of course, on network bandwidth and other factors that affect system resources).

Once a system administrator has created a Virtual Fields Activity, Domino users can open, create, update or delete external system data directly and transparently through their Notes client. By extension, Web clients may open the same Notes form that the activity monitors by accessing a Domino 6 server and obtaining access to supported external source data.

For example, if the external database to be queried or updated from the Notes form is a DB2 database, Notes end-users may work with DB2 data as if it were in Notes. DB2 connectivity software is not required on the client system; however, it must be installed on the Domino server machine. Network access to the external data source is handled by the Domino server machine, which contains DECS connectivity software for the external data source, such as DB2.



**Note:** Refer to the *Domino Enterprise Connection Services User Guide* for additional information on configuring DECS and developing Domino applications with virtual fields.

### 5.3.4 Creating the Domino application

For the purposes of this redbook, we chose a simple Domino 6 application and DB2 for Linux. The Domino application pulls data from the SAMPLE database created by DB2. The EMPNO, FIRSTNAME and LASTNAME fields were populated with an agent at the creation of the Domino application, but all remaining fields pull data dynamically from DB2.

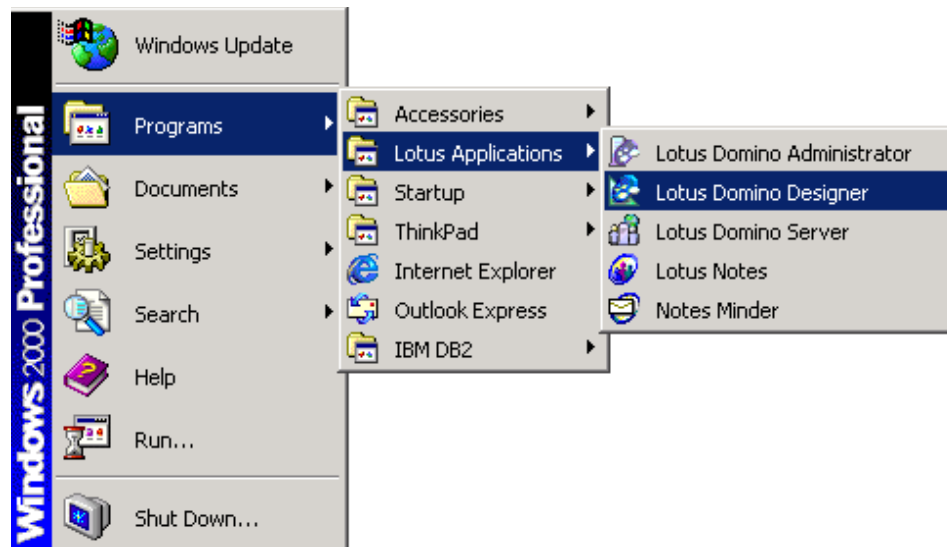


Figure 5-67 Start Domino Designer

We begin by starting the Domino 6 Designer from a Windows 2000 workstation. Although we installed the Domino 6 Administrator client with CrossOver Office earlier, we are using a Windows environment for application development.

**Note:** You can download the database template we are using from the Redbooks Web site. More information about using the additional material is in Appendix B, "Additional material" on page 445.

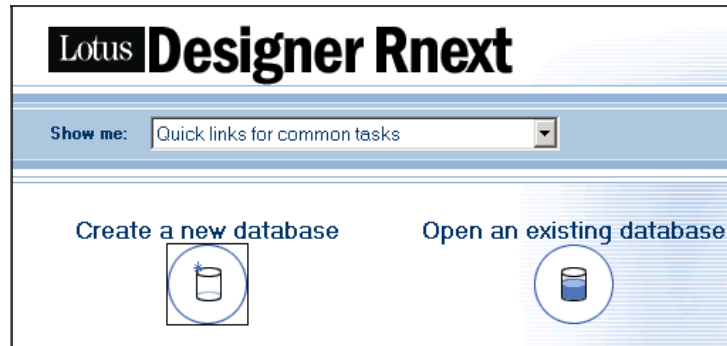


Figure 5-68 Domino Designer: Creating a new database

Within Domino Designer, select **Create a new database**.

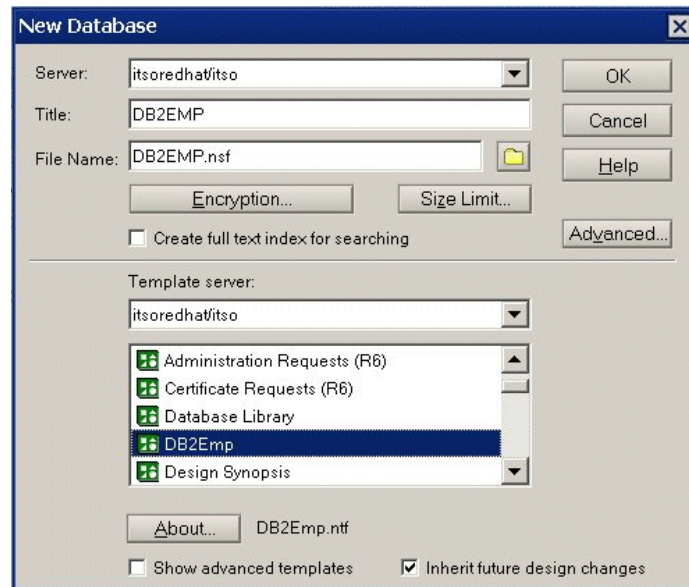


Figure 5-69 Domino Designer: New Database

For the server, enter the name of the Domino 6 server where you just completed the Domino for Linux installation and the DB2 for Linux installation. If this were a production application the Domino and DB2 servers probably would not be on the same machine.

Choose a name for your application. We chose DB2EMP. The Domino 6 template for this application is identically named.

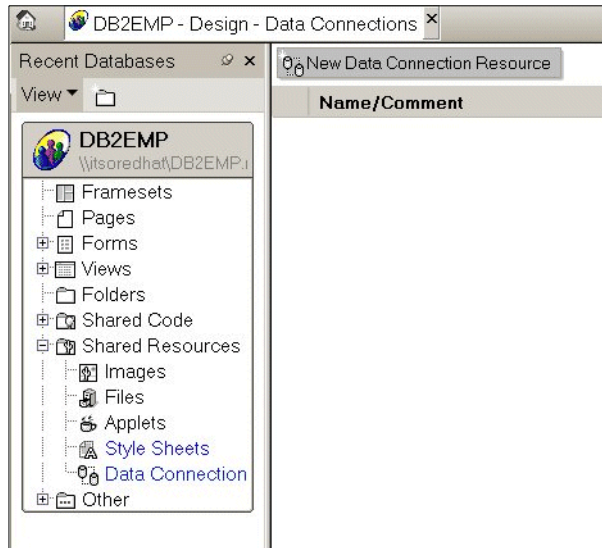


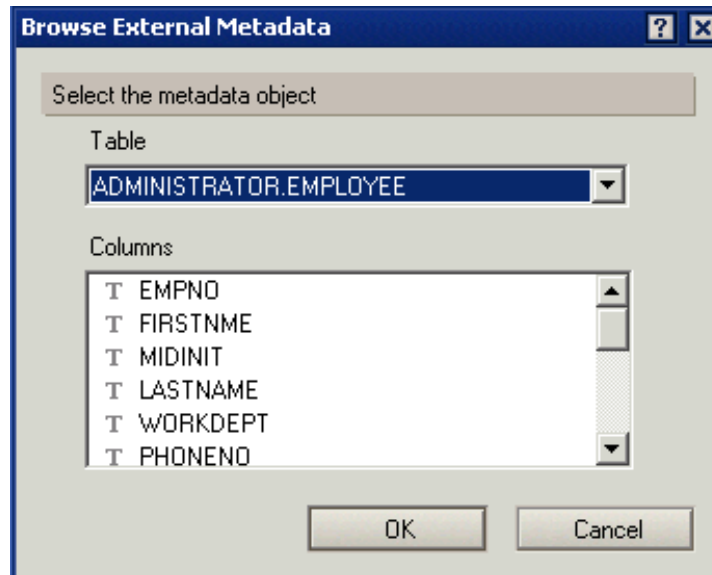
Figure 5-70 Domino Designer: Data Connection

In the left pane of the Designer, under Recent Databases, select **Shared Resources -> Data Connections -> New Data Connection Resources**.

The screenshot shows the 'Data Connection' dialog box. It has a title bar with 'Data Connection' and standard window controls. Below the title bar is a toolbar with icons for creating, opening, saving, and other actions. The main area contains several input fields and a 'Browse metadata' button. The fields are organized into sections: 'Name' (DB2), 'Alias' (empty), 'Comment' (empty), 'Connectivity' (Class: RDBMS, Type: DB2, User name: db2inst1, Password: password, Database: SAMPLE), 'Object' (radio buttons for Table, View, Procedure), 'Owner' (empty), 'Name' (empty), and 'Search' (empty). The 'Table' radio button is selected under the 'Object' section.

Figure 5-71 Domino Designer: DB2 Data Connection

On the Data Connection dialog box, enter a name of DB2. For Class and Type enter RDBMS and DB2 respectively. For User Name enter Administrator or the appropriate account for your DB2 installation and supply the password in the Password field. For Database enter SAMPLE, then click **Browse Metadata**.



*Figure 5-72 Domino Designer: Browse Administrator.Employee*

In the Browse External Metadata dialog box, select **ADMINISTRATOR.EMPLOYEE** for Table, then click **OK** to close the dialog.

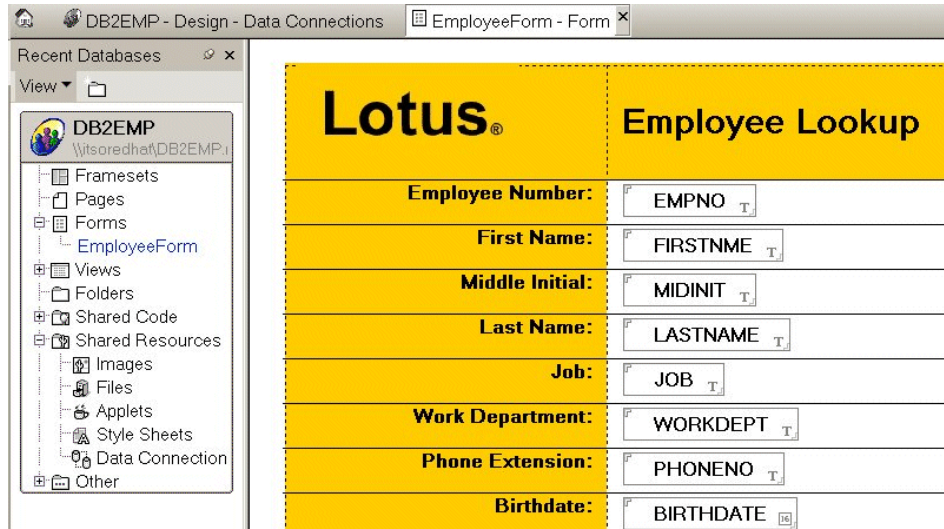


Figure 5-73 Domino Designer: Employee Form

Next, select the **Forms** icon in the navigation pane, then select **EmployeeForm**.

**Field**

Name: EMPNO

Type: Text (Editable)

☐ Allow multiple values

☐ Compute after validation

☒ External data source

Style: ☒ Notes style ☐ Native OS style

☐ Align control's with paragraph's baseline

Size: Width 1.000" Fixed (Size) Height 0.250" Fixed

Tab Key: Position in tab order 0 ☐ Give field initial (default) focus

Data Source Options:

External field name:

Metadata object name:

Data connection resource:

☐ Store data locally ☐ Key field ☒ Data field

Figure 5-74 Domino Designer: EMPNO field properties

Double-click the **EMPNO** field to open the field properties dialog. Enable “External data source” by checking that box. Next to “Data Sources Options” select **Browse**.

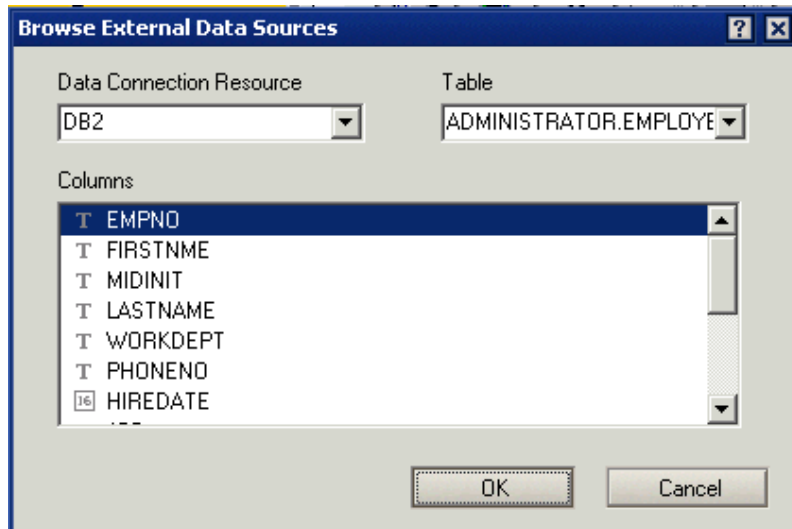


Figure 5-75 Domino Designer: Browse DB2 EMPNO

For Data Connection Resource select **DB2**; for Table select **ADMINISTRATOR.EMPLOYEE**; for Columns select **EMPNO**; then click **OK**.

The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'EMPNO'. The 'Type' is 'Text' and 'Editable'. The 'External data source' checkbox is checked. The 'Style' section has 'Notes style' selected. The 'Size' section shows 'Width' as 1.000" and 'Height' as 0.250". The 'Tab Key' section shows 'Position in tab order' as 0. The 'Data Source Options' section shows 'External field name' as 'EMPNO', 'Metadata object name' as 'ADMINISTRATOR.EMPLO', and 'Data connection resource' as 'DB2'. The 'Key field' radio button is selected.

Name		EMPNO
Type	Text	Editable
<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source		
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's with paragraph's baseline	
Size	Width	1.000" Fixed (Size)
	Height	0.250" Fixed
Tab Key	Position in tab order 0 <input type="checkbox"/> Give field initial (default) focus	
Data Source Options <span style="float: right;">Browse</span>		
External field name	EMPNO	
Metadata object name	ADMINISTRATOR.EMPLO	
Data connection resource	DB2	
<input checked="" type="radio"/> Key field <input type="radio"/> Data field		

Figure 5-76 Domino Designer: EMPNO Key field selection

On the very bottom of the properties dialog, select **Key Field**.



The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'FIRSTNME'. The 'Type' is 'Text' and 'Editable'. Under 'Style', 'Notes style' is selected. Under 'Size', 'Width' is 1.000" and 'Height' is 0.250". Under 'Tab Key', 'Position in tab order' is 0. Under 'Data Source Options', 'External field name' is 'FIRSTNME', 'Metadata object name' is 'ADMINISTRATOR.EMPLO', and 'Data connection resource' is 'DB2'. The 'Data field' radio button is selected.

Name		FIRSTNME	
Type	Text	Editable	
<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source			
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's with paragraph's baseline		
Size	Width	1.000"	Fixed (Size)
	Height	0.250"	Fixed
Tab Key	Position in tab order 0		
<input type="checkbox"/> Give field initial (default) focus			
Data Source Options		Browse	
External field name	FIRSTNME		
Metadata object name	ADMINISTRATOR.EMPLO		
Data connection resource	DB2		
<input type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field			

Figure 5-77 Domino Designer: FIRSTNME field properties

Close the properties dialog and double-click the **FIRSTNME** field to open the properties dialog for that field. Enable “External data source;” next to “Data Source Options” select **Browse**.

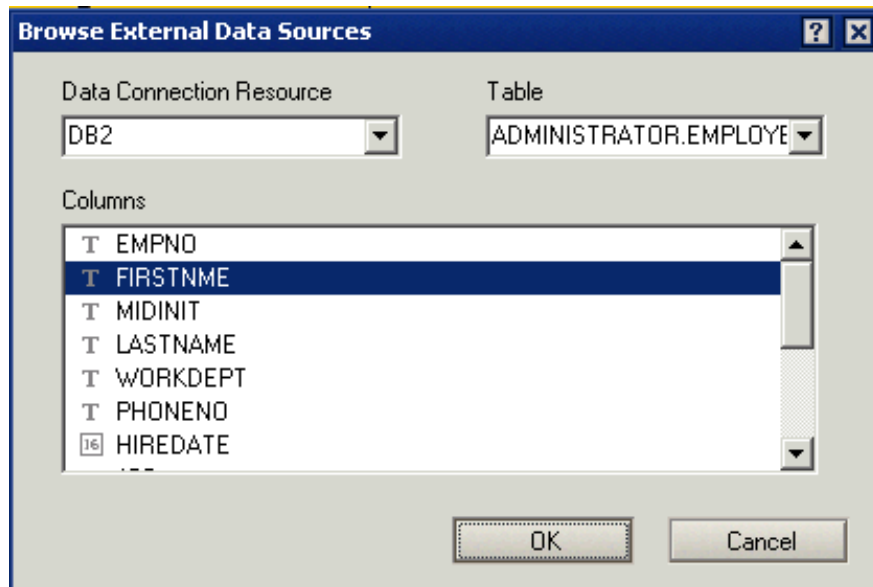


Figure 5-78 Domino Designer: Browse DB2 FIRSTNME

For Data Connection Resource select **DB2**; for Table select **ADMINISTRATOR.EMPLOYEE**; for Columns select **FIRSTNME**; then click **OK**.

The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'FIRSTNME'. The 'Type' is 'Text' and 'Editable'. The 'Style' section has 'Notes style' selected. The 'Size' section shows 'Width' as 1.000" and 'Height' as 0.250". The 'Tab Key' section shows 'Position in tab order' as 0. The 'Data Source Options' section shows 'External field name' as 'FIRSTNME', 'Metadata object name' as 'ADMINISTRATOR.EMPLO', and 'Data connection resource' as 'DB2'. The 'Store data locally' checkbox is checked, and 'Data field' is selected.

Name	FIRSTNME		
Type	Text	Editable	
	<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source		
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's with paragraph's baseline		
Size	Width	1.000"	Fixed (Size)
	Height	0.250"	Fixed
Tab Key	Position in tab order 0		
	<input type="checkbox"/> Give field initial (default) focus		
Data Source Options	Browse		
External field name	FIRSTNME		
Metadata object name	ADMINISTRATOR.EMPLO		
Data connection resource	DB2		
	<input checked="" type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field		

Figure 5-79 Domino Designer: FIRSTNME data field selection

Back on the properties dialog, enable “Store data locally.” This allows you to view the data in a view.

Close the properties dialog and double-click the **LASTNAME** field to open the properties dialog for that field.

The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'LASTNAME'. The 'Type' is 'Text' and 'Editable'. Under 'Style', 'Notes style' is selected. Under 'Size', 'Width' is '1.000"' and 'Height' is '0.250"', both set to 'Fixed'. Under 'Tab Key', 'Position in tab order' is '0'. Under 'Data Source Options', 'Store data locally' is checked, and 'Data field' is selected. The 'External field name' is 'LASTNAME', 'Metadata object name' is 'ADMINISTRATOR.EMPLO', and 'Data connection resource' is 'DB2'. A 'Browse' button is visible next to 'Data Source Options'.

Name	LASTNAME	
Type	Text	Editable
	<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source	
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's with paragraph's baseline	
Size	Width 1.000"	Fixed (Size)
	Height 0.250"	Fixed
Tab Key	Position in tab order 0 <input type="checkbox"/> Give field initial (default) focus	
Data Source Options	Browse	
External field name	LASTNAME	
Metadata object name	ADMINISTRATOR.EMPLO	
Data connection resource	DB2	
	<input checked="" type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field	

Figure 5-80 Domino Designer: LASTNAME field properties

Enable “External data source;” next to “Data Source Options,” select **Browse**.

The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'LASTNAME'. The 'Type' is 'Text' and 'Editable' is checked. Under 'Style', 'Notes style' is selected. Under 'Size', 'Width' is 1.000" and 'Height' is 0.250". Under 'Tab Key', 'Position in tab order' is 0. Under 'Data Source Options', 'External field name' is 'LASTNAME', 'Metadata object name' is 'ADMINISTRATOR.EMPLO', and 'Data connection resource' is 'DB2'. The 'Store data locally' checkbox is checked, and 'Data field' is selected under the radio buttons.

Name		LASTNAME
Type	Text	Editable
<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source		
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's with paragraph's baseline	
Size	Width 1.000"	Fixed (Size)
	Height 0.250"	Fixed
Tab Key	Position in tab order 0 <input type="checkbox"/> Give field initial (default) focus	
Data Source Options <a href="#">Browse</a>		
External field name	LASTNAME	
Metadata object name	ADMINISTRATOR.EMPLO	
Data connection resource	DB2	
<input checked="" type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field		

Figure 5-81 Domino Designer - LASTNAME Data Field Selection

For Data Connection Resource select **DB2**; for Table select **ADMINISTRATOR.EMPLOYEE**; for Columns select **LASTNAME**; then click **OK**. Back on the properties dialog, enable “Store data locally.” This allows you to view the data in a view.

For all remaining fields in the EmployeeForm, repeat these steps to enable “External data source” and browse the “Data source options” to ensure you select the correct DB2 column for the field you are working with. *Do not* enable “Store data locally” for any additional fields.

Once you’ve completed the modifications for each field, press Esc to close the form and select **Yes** to save it.

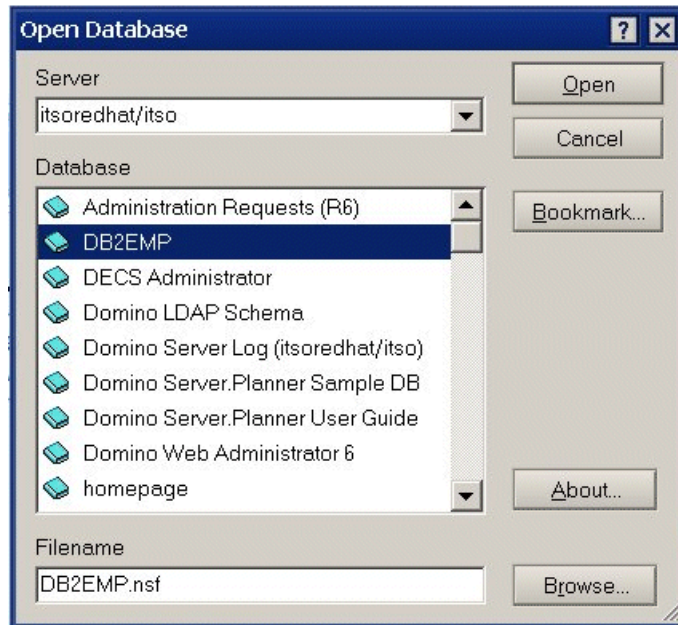


Figure 5-82 Lotus Notes Client: Database Open DB2EMP

The new database is empty at this point. To populate the fields for which we chose to store data locally (EMPNO, FIRSTNAME, LASTNAME) we need to initialize the keys (using the agent in the example database) by creating a document with the above reference fields. To do this, start the Lotus Notes client and open the new database.

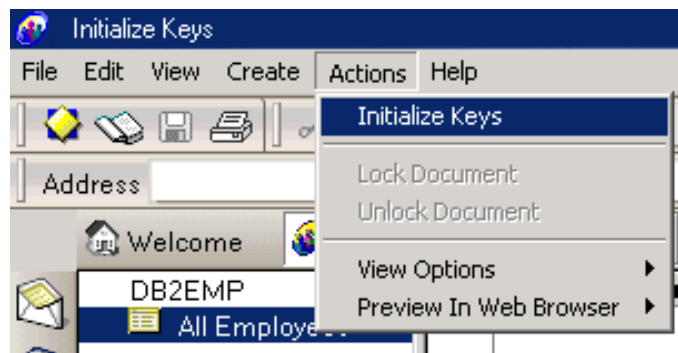
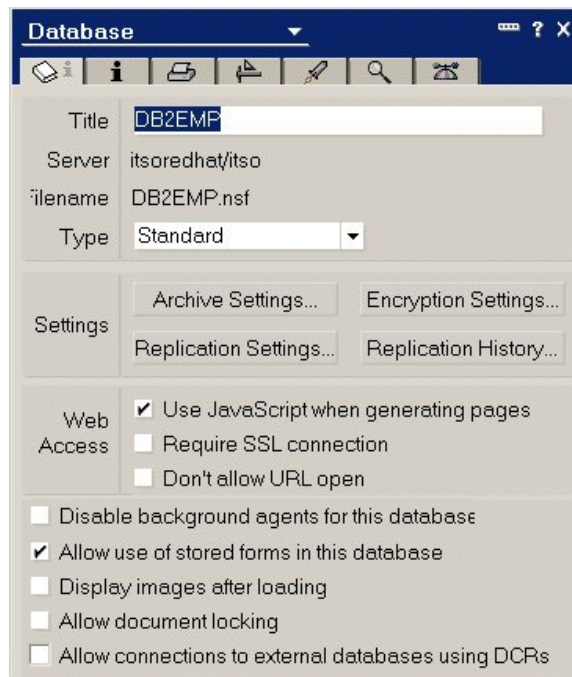


Figure 5-83 Lotus Notes Client: Initialize keys

Once the database is open you will notice the default view (All Employees) is empty. From the menu bar select **Action**, then select **Initialize Keys**. When the agent finishes you should see documents in the view.

**Note:** The **Initialize Keys** agent is part of the DB2EMP sample application.



*Figure 5-84 Domino Designer: Database properties*

Return to Domino Designer to enable the connectivity to the external data source that we configured previously. Select **File -> Database -> Properties** and near the bottom of the properties dialog enable “Allow connections to external databases using DCRs.”

Click **OK** in the confirmation dialog.

Employee Number	Last Name	First Name
000010	HAAS	CHRISTINE
000020	THOMPSON	MICHAEL
000030	KWAN	SALLY
000050	GEYER	JOHN
000060	STERN	IRVING

Figure 5-85 Lotus Notes client: All Employees view

Now to confirm the external connection is working, return to the Lotus Notes client and open the database. From the All Employee view, double-click one of the documents to open it. You should see all of the fields populated with data, similar to Figure 5-86. Except for the EMPNO, FIRSTNAME, and LASTNAME fields, all other field data is stored in DB2.

Lotus Employee Lookup	
Employee Number:	000010
First Name:	CHRISTINE
Middle Initial:	I
Last Name:	HAAS
Job:	PRES
Work Department:	A00
Phone Extension:	3978
Birthdate:	08/24/1933
Hiredate:	01/01/1965
Sex:	F
Education Level:	18
Bonus:	\$1,000.00
Commision:	\$4,220.00
Salary:	\$52,750.00

Figure 5-86 Lotus Notes Client - Employee Lookup Form



That's it! You have successfully used a Domino application to access employee data in a DB2 database. This process can easily be modified to work with production data in a production application.

## **5.4 Accessing external data from Domino: MySQL example**

You can gain a number of benefits when a relational database management system (RDBMS) and Domino are combined. This effectively allows you to bypass the constraints of the flat database architecture that Domino uses natively. A Domino database can now be mostly used for configuration, design, and security issues, while leaving storage issues to the RDBMS. Also, an RDBMS housed on a Linux server takes advantage of the performance and scalability both of these technologies are well known for. Organizations utilizing a separate backend database now have more control over their architecture and system performance of Domino mail and applications as well. For example, you can house the RDBMS on a separate server that can focus on managing data while another machine can work on security, management, and presentation.

MySQL represents a solid backend that when combined with Domino and Linux, leverages the inherent and complementary strengths of UNIX and RDBMS systems. And since MySQL is available under the GNU General Public License, it is available for anybody to use and download.

Noted for its speed and reliability, MySQL has been accepted as a viable solution for a broad range of needs. MySQL is billed as “the world's most popular open source database.” All these factors add up to MySQL being a low cost, powerful, and effective counterpart to the Notes/Domino system.

This section provides instructions for setting up MySQL to work as the Domino backend. It demonstrates the simplicity of integrating an RDBMS. A high-level view of the steps involved includes:

1. Determining the environment in which you want to work. This requires making some choices about what products and versions to use.
2. Installing MySQL.
3. Basic tuning.
4. Setup and configuration of MySQL.
5. Setup and configuration of the Notes/Domino Application.

## 5.4.1 Description of the environment

The recommended Domino server configuration is to use a dedicated server machine for the Domino server. However, in our lab environment, we implemented a system with Domino and MySQL on the same machine.

### **Linux**

In our example, we used RedHat 7.2 with kernel 2.4.7-6. It is highly recommended by MySQL to use the 2.4 kernel at the minimum, as stability and performance are much better than with the 2.2 kernel.

### **Domino**

As with the DB2 example, we assume that you have installed Domino 6 and chosen DECS to be installed as an additional service during setup.

### **MySQL**

For the latest information about MySQL and to download the latest version, check the MySQL Web site at:

<http://www.mysql.com>

There are several choices that you will need to make when getting started with MySQL:

1. Which MySQL version do you want to use? The MySQL AB Company recommends going with the latest stable release since it incorporates the best balance between features and stability. As of this writing 3.23 is the current recommended version and 4.0 is released in a beta version. This discussion is based on 3.23, which is the version we installed in the lab.
2. The second choice you need to address is which MySQL product is best suited to your needs. MySQL 3.23 offers 2 different “flavors”:
  - a. MySQL, the basic release
  - b. MySQL-Max, which adds high-end features to MySQL, notably transaction support

We chose the basic MySQL release to keep our example simple.

MySQL currently has a beta version of release 4 available. If we had chosen to use the release 4 version, there would have been 4 options:

- a. MySQL 4, the basic release
- b. MySQL Classic, optimized for raw speed without transactions
- c. MySQL Pro, essentially MySQL Classic with transaction support
- d. MySQL-Max, which offers two table handlers (InnoDB & BDB) that provide transaction support to MySQL

3. Next, choose the architecture of your Domino system. In some cases, it may prove useful to house the MySQL server on a different machine. For the sake of simplicity both the Domino server and the MySQL server were housed on the same machine in our lab, so this is what our discussion is based upon.
4. The last choice to make is how you wish to install MySQL. For Linux there are three options:
  - a. A source installation, which will necessitate compiling the code on your machine. This offers the most flexibility but carries the highest level of complexity.
  - b. A binary installation in which all the necessary files are compiled and organized in a tar file.
  - c. An rpm file, which is the simplest installation and even starts the daemon for you. It also happens to be the method recommended by MySQL for Linux installations.

Because we are aiming for simplicity in this demonstration, we chose the rpm method of installation. This method of installation has an rpm package for each logical bundle of files. Here is the listing from the MySQL manual:

- MySQL-VERSION.i386.rpm  
The MySQL server.
- MySQL-client-VERSION.i386.rpm  
The standard MySQL client programs.
- MySQL-bench-VERSION.i386.rpm  
Tests and benchmarks. Requires Perl and msql-mysql-module rpms.
- MySQL-devel-VERSION.i386.rpm  
Libraries and include files needed if you want to compile other MySQL clients, such as the Perl modules.
- MySQL-VERSION.src.rpm  
The source code for all of the previous packages.

We want to install the server and the client.

## MyODBC/unixODBC

Domino doesn't support MySQL directly, but it does support ODBC. You can use MyODBC to provide you with a driver. The current stable version of MyODBC is 2.50; it can be downloaded from:

<http://www.mysql.com>

MyODBC requires the client shared libraries, so you need to install this as a prerequisite to MyODBC. This comes as the package MySQL-shared-VERSION.i386.rpm or MySQL-devel-VERSION.i386.rpm.

Finally, you need an ODBC manager to manage access to the data sources on Linux. The unixODBC package follows the unixODBC-VERSION.i386.rpm naming scheme. It comes with most Linux distributions, or it can be downloaded from:

<http://www.unixodbc.org>

To recap, the choices for this section are:

MySQL-VERSION.i386.rpm Available from <http://www.MySQL.com>

MySQL-client-VERSION.i386.rpm Available from <http://www.MySQL.com>

MySQL-shared-VERSION.i386.rpm Available from <http://www.MySQL.com>

MyODBC-VERSION-i386.rpm Available from <http://www.MySQL.com>

unixODBC-VERSION.i386 Available with your distribution of Linux or from  
<http://www.unixodbc.org>

## 5.4.2 Installing MySQL

Just as we did with the Domino install, all installations must be done as the root user. Linux does not allow the root user to telnet in from another machine. In order to install remotely, you have to login as another user and switch to the root user using the command `su -`.

### *Server and client*

Installation is as simple as running `rpm -i` on the server and client packages.

```
[root@dyn9-243-89-153 notes1# ls
Desktop      MySQL-client-3.23.52-1.i386.rpm
MySQL-3.23.52-1.i386.rpm  MySQL-Max-3.23.52-1.i386.rpm
[root@dyn9-243-89-153 notes1# rpm -i MySQL-3.23.52-1.i386.rpm MySQL-client-3.23
.52-1.i386.rpm
Installing all prepared tables
020910 0:11:03 /usr/sbin/mysqld: Shutdown Complete

PLEASE REMEMBER TO SET A PASSWORD FOR THE MySQL root USER !
This is done with:
/usr/bin/mysqladmin -u root password 'new-password'
/usr/bin/mysqladmin -u root -h dyn9-243-89-153 password 'new-password'
See the manual for more instructions.

NOTE: If you are upgrading from a MySQL <= 3.22.10 you should run
the /usr/bin/mysql_fix_privilege_tables. Otherwise you will not be
able to use the new GRANT command!

Please report any problems with the /usr/bin/mysqlbug script!

The latest information about MySQL is available on the web at
http://www.mysql.com
Support MySQL by buying support/licenses at https://order.mysql.com

Starting mysqld daemon with databases from /var/lib/mysql
[root@dyn9-243-89-153 notes1#
```

Figure 5-87 Telnet session: Installing MySQL server and client

## MyODBC/unixODBC

Installation of the MySQL shared libraries, MyODBC, and unixODBC is much the same. In this example, we demonstrate using the form `rpm -ivh`. The difference is that the packages are installed as before, but now we receive verbose output in case a problem occurs. Hashing will also occur so we can see the progress of the install.

Notice that the MySQL shared libraries must be installed before MyODBC.

```
[root@suplab03 notes]# rpm -ivh MySQL-shared-3.23.52-1.i386.rpm
Preparing... ##### [100%]
1:MySQL-shared ##### [100%]
[root@suplab03 notes]# rpm -ivh MyODBC-2.50.39-1.i386.rpm
Preparing... ##### [100%]
1:MyODBC ##### [100%]
[root@suplab03 notes]# rpm -ivh unixODBC-2.2.0-5.i386.rpm
Preparing... ##### [100%]
1:unixODBC ##### [100%]
[root@suplab03 notes]#
```

Figure 5-88 Telnet session: Installing MySQL shared libraries, MyODBC and unixODBC

Finally, to get connectivity to work, you need to make sure the ODBC shared library (`libodbc.so.1.x.x`) is available to Domino. Domino will actually look for this library under the name `libodbc.so`. Therefore, you need to make a symbolic link named `libodbc.so` in the Domino binaries directory that has the `/usr/lib/libodbc.so.1.x.x` file as the target. The command for this is:

```
ln -s /usr/lib/libodbc.so.1.x.x /opt/lotus/notes/latest/linux/libodbc.so
```

### 5.4.3 Basic tuning

Basic performance considerations require that we do some basic tuning.

In `/etc/sysctl.conf`, we make sure the following values are either added or already set to at least the amounts shown:

```
fs.file-max=65536
```

```
fs.super-max=1024
```

In Chapter 4, “Performance, scalability, and troubleshooting” on page 195 we recommended setting the `fs.file-max` parameter in the `/etc/sysctl.conf` to at least 49152. Here we are just increasing that parameter to fall in line with MySQL recommendations.

Make sure the following lines are included in `/etc/my.cnf`. Each entry in brackets represents a section and the parameter setting afterwards belongs to that section. It may be necessary to create this file yourself.

```
[mysqld]
set-variable = max_connections=256

[safe_mysqld]
open-files-limit = 8192
```

**Note:** If you want to use a default configuration, you can go to the /usr/share/mysql directory and choose one of the configurations there. The naming scheme of these samples is my-SIZE.cnf (that is, my-small.cnf). Simply copy them to the /etc directory using the command:

```
cp /usr/share/mysql/my-SIZE.cnf /etc/my.cnf)
```

Add the following line to /usr/bin/safe\_mysqld after the line "echo "Starting \$MYSQLD daemon with databases from \$DATADIR"":

```
renice -20 $$
```

```
##
## Uncomment the following lines if you want all tables to be automatically
## checked and repaired at start
##
## echo "Checking tables in $DATADIR"
## $MY_BASEDIR_VERSION/bin/myisamchk --silent --force --fast --medium-check -O key_buffer=64M -O sort_buffer=64M $DATADIR/*/*.MYI
## $MY_BASEDIR_VERSION/bin/isamchk --silent --force -O sort_buffer=64M $DATADIR/*/*.ISM

echo "Starting $MYSQLD daemon with databases from $DATADIR"
renice -20 $$
# Does this work on all systems?
# if type ulimit ! grep "shell builtin" > /dev/null
# then
#   ulimit -n 256 > /dev/null 2>&1           # Fix for BSD and FreeBSD systems
# fi

echo "`date +%y%m%d %H:%M:%S`  mysqld started" >> $err_log
while true
do
  rm -f $MYSQL_UNIX_PORT $pid_file      # Some extra safety
  if test -z "$args"
```

Figure 5-89 Telnet session: Adding "renice -20 \$\$" to safe\_mysqld

Reboot the server to make sure all the settings take effect. This is done when the root user issues the command **reboot**.

## Confirming settings

The first thing to do after the server restarts is to make sure all the changes have been updated properly. We can check the priority number by issuing **ps -el | more**. The values under the NI column for safe\_mysqld and mysqld should be negative.

```

140 $      0 12426      1 0 69 0 - 497 do_sys ?      00:00:00 klogd
140 $      32 12446      1 0 69 0 - 388 do_pol ?      00:00:00 portmap
140 $      29 12474      1 0 69 0 - 423 do_sel ?      00:00:00 rpc.statd
1 0 69 0 - 669 do_sel ?      00:00:00 sshd
140 $      0 12619      1 0 69 0 - 566 do_sel ?      00:00:00 xinetd
140 $      0 12659      1 0 69 0 - 1321 do_sel ?      00:00:00 sendmail
040 $      0 12678      1 0 69 0 - 360 do_sel ?      00:00:00 gpm
040 $      0 12696      1 0 69 0 - 396 nanosl ?      00:00:00 crond
100 $      0 12703      1 0 59 -20 - 560 wait4 ?      00:00:00 safe_mysq
1 0 69 0 - 1140 do_sel ?      00:00:00 xfs
100 $     100 12771 12703 0 63 -15 - 2644 do_sel ?      00:00:00 mysqld
040 $     100 12773 12771 0 63 -15 - 2644 do_pol ?      00:00:00 mysqld
040 $     100 12774 12773 0 63 -15 - 2644 rt_sig ?      00:00:00 mysqld
040 $      2 12810      1 0 69 0 - 361 nanosl ?      00:00:00 atd
100 $      0 12833      1 0 69 0 - 579 wait4 tty1      00:00:00 login
100 $      0 12834      1 0 69 0 - 346 read_c tty2      00:00:00 mingetty
100 $      0 12835      1 0 69 0 - 346 read_c tty3      00:00:00 mingetty
100 $      0 12836      1 0 69 0 - 346 read_c tty4      00:00:00 mingetty
100 $      0 12839      1 0 69 0 - 346 read_c tty5      00:00:00 mingetty
100 $      0 12840      1 0 69 0 - 346 read_c tty6      00:00:00 mingetty
100 $      0 12841 12833 0 68 0 - 617 read_c tty1      00:00:00 bash
100 $      0 12888 12619 0 72 0 - 437 do_sel ?      00:00:00 in.telnet
888 0 70 0 - 607 wait4 pts/2 00:00:00 login
100 $     501 12890 12889 0 77 0 - 611 wait4 pts/2 00:00:00 bash
000 R     501 12956 12890 0 78 0 - 765 - pts/2 00:00:00 ps
040 R     501 12957 12890 0 77 0 - 611 - pts/2 00:00:00 bash
[notes@dyn9-243-89-153 notes]$

```

Figure 5-90 Telnet session: Verifying that "renice -20 \$\$" is working

You can check that values in the `/etc/my.cnf` are being read by the MySQL server correctly by issuing:

```
mysqladmin variables
```

**Note:** If a mysql password has been set for the user you are logged in as (which is different from the Linux password), you will need to use the `-p` flag. This will inform the MySQL client that you want to start a session with a password.

```

[root@dyn9-243-89-153 root]# mysqladmin -p variables!grep max_connections
Enter password:
! max_connections                ! 256
!
[root@dyn9-243-89-153 root]#

```

Figure 5-91 Telnet session: Verifying `max_connections`

There is a variable named `open_files_limit` which is different than the parameter that was set in the `my.cnf`, so a difference in value is normal. This can sometimes be confusing for someone who is reviewing the parameters.

You can check the value of the `/etc/sysctl.conf` by typing the following:

```
cat /proc/sys/fs/file-max
cat /proc/sys/fs/super-max
```

```

[root@dyn9-243-89-153 fs]# cat /proc/sys/fs/file-max
65536
[root@dyn9-243-89-153 fs]# cat /proc/sys/fs/super-max
1024
[root@dyn9-243-89-153 fs]# _

```

Figure 5-92 Telnet session: Verifying Linux parameters have been updated

## 5.4.4 Configure MySQL

For this section, we focus on the following tasks:

1. Setting passwords. This is the first thing that should be done for the root user after an install.
2. Creating a user for Domino to use when connecting to the database.
3. Creating the database that will house the Domino application data.
4. Creating a table for use in managing and organizing the data in the database.
5. Configuring ODBC.

For the purpose of this example, we are connecting to the MySQL server with the MySQL client, which happens to be text-based. Since we are connecting to the same host our remote session is on, connecting is as simple as issuing:

```
mysql -u user -p
```

This will bring us to a command line environment that is connected to the MySQL server.

```

[notes@dyn9-243-89-153 linux]$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 36 to server version: 3.23.52-log
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.
mysql> _

```

Figure 5-93 MySQL Client session: Starting the client

Here are some basic commands to help you get around in MySQL:

SHOW DATABASES; Displays the databases on the system

USE <database> Connects to a specific database

SHOW TABLES Displays the tables in the database currently being accessed



SELECT DATABASE();Displays the database currently being accessed.

SELECT <column> FROM <table>;Gets the column data from the table

We will also be using the MySQL administration tool, which conveniently happens to be named “mysqladmin.” We use this to send certain administrative commands to the MySQL server, for example:

```
mysqladmin -u user -p <command>
```

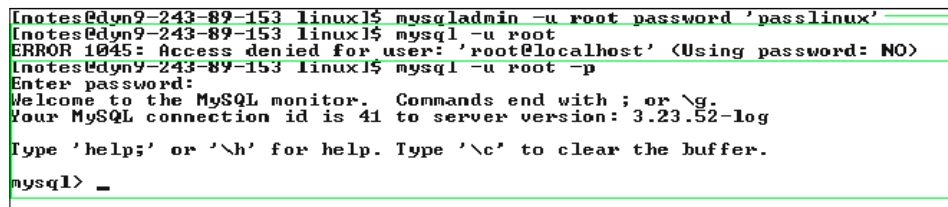
## Setting passwords

Once the tuning parameters are in place, we need to configure the MySQL server itself. The first place to start is by setting the root password:

```
mysqladmin -u root password 'your_password'
```

You can test that the password is set correctly by typing **mysql -u root -p**. The client should ask for your password. Given the correct password, it should start up a session with the MySQL server.

In Figure 5-94, the first line shows setting the password; the next two lines show the user attempting to access the server without the password; and the last six lines are the result of starting a session with the password.

A terminal window showing a series of commands and their outputs. The first command is 'mysqladmin -u root password 'passlinux'', which executes successfully. The second command is 'mysql -u root', which results in an 'ERROR 1045: Access denied for user: 'root@localhost' (Using password: NO)'. The third command is 'mysql -u root -p', which prompts for a password. After entering the password, the MySQL client connects to the server, displaying a welcome message, connection ID, and server version. The prompt then changes to 'mysql>'.

```
[notes@dyn9-243-89-153 linux]$ mysqladmin -u root password 'passlinux'
[notes@dyn9-243-89-153 linux]$ mysql -u root
ERROR 1045: Access denied for user: 'root@localhost' (Using password: NO)
[notes@dyn9-243-89-153 linux]$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 41 to server version: 3.23.52-log

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> _
```

Figure 5-94 MySQL client: Verifying that the root password is instantiated

## Creating users

You should also create a new user so that Domino doesn't have to connect as root. Do this with the following steps:

1. Start the mysql command line environment with the command:

```
mysql -u root -p
```

2. Next, as root, create the user using the command line template:

```
mysql>GRANT usage on database.table TO username@localhost
->IDENTIFIED BY 'password';
```

```

[notes@dyn9-243-89-153 linux]$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 33 to server version: 3.23.52-log

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> grant usage on *.* to testuser@localhost
-> identified by 'testpass'
-> ;
Query OK, 0 rows affected (0.00 sec)

mysql> grant usage on *.* to testuser@"dyn9-243-89-153"
-> identified by 'testpass';
Query OK, 0 rows affected (0.00 sec)

mysql>

```

Figure 5-95 MySQL client: Creating users on the MySQL system with "usage" rights

Note that a host may go by many names. The host may be referred to as localhost, the ip address, the host name, or the fully qualified name. But the rights assigned to a user/host combination are unique. So if a user was being recognized as user@host.com and user@host.ibm.com, the user table would need to have entries for both. In this example, we created a user where the machine the user is connecting from is identified as both the host name and localhost. Both of these are possible names for this machine.

This command set will create a user entry in the mysql database in the user table. This user will be given usage privileges and set the password to password.

The next example:

1. Creates a user named testuser on the operating system.
2. Grants the privilege type usage to connect to all tables. Usage will only provide connectivity rights. You will have to apply further privileges later, in order to actually work with the tables.
3. Sets the MySQL password to testpass.

If you later need to remove the user, you can just revoke all the privileges of the user. For example:

```

mysql> REVOKE ALL PRIVILEGES ON *.*
-> FROM username@localhost;
mysql> flush privileges;

```

Although this removes all the rights of the user, the user will still be listed in the mysql.user table. The only way to remove the user completely is to remove him from the user table with:

```

mysql> DELETE FROM user WHERE user = 'username';
mysql> flush privileges;

```

You can verify that the user has been created by connecting to the mysql database and displaying the users in the user table.

```
mysql> use mysql
Database changed
mysql> show tables;
+-----+
| Tables_in_mysql |
+-----+
| columns_priv     |
| db               |
| func            |
| host            |
| tables_priv     |
| user            |
+-----+
6 rows in set (0.00 sec)

mysql> select * from user;
+-----+-----+-----+-----+-----+-----+-----+
| Host      | User      | Password      | Select_priv | Insert_priv | Upd |
| Create_priv | Drop_priv | Reload_priv | Shutdown_priv | Process_priv | Fil |
| References_priv | Index_priv | Alter_priv |               |               |     |
+-----+-----+-----+-----+-----+-----+-----+
| localhost | root      | 3f431ce55a9b5117 | Y           | Y           | Y   |
| Y         | Y         | Y           | Y           | Y           | Y   |
| dyn9-243-89-153 | root      | Y           | Y           | Y           | Y   |
| Y         | Y         | Y           | Y           | Y           | Y   |
| localhost | N         | N           | N           | N           | N   |
| N         | N         | N           | N           | N           | N   |
| dyn9-243-89-153 | N         | N           | N           | N           | N   |
| N         | N         | N           | N           | N           | N   |
| localhost | testuser  | 7dcda0d57290b453 | N           | N           | N   |
| N         | N         | N           | N           | N           | N   |
| dyn9-243-89-153 | testuser  | 7dcda0d57290b453 | N           | N           | N   |
| N         | N         | N           | N           | N           | N   |
+-----+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)
```

Figure 5-96 MySQL client: Displaying the mysql tables and verifying users have been created

You can also verify that privileges have been properly assigned by testing the connectivity of testuser on the database server, as shown in Figure 5-97.

```

[root@dyn9-243-89-153 root]# mysql -u testuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 26 to server version: 3.23.52
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> use test
Database changed
mysql> show tables;
Empty set (0.00 sec)

mysql> _

```

Figure 5-97 MySQL client: Verifying that our testuser can connect to the system

Finally, you can assign privileges to the user you have created. For the sake of simplicity, we demonstrate assigning all rights to all the databases and tables on the database server.

```

[notes@dyn9-243-89-153 notes]# mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 34 to server version: 3.23.52
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> grant all privileges on *.* to testuser@localhost;
Query OK, 0 rows affected (0.00 sec)

mysql> grant all privileges on *.* to testuser@"dyn9-243-89-153";
Query OK, 0 rows affected (0.00 sec)

mysql> flush privileges;
Query OK, 0 rows affected (0.00 sec)

mysql>

```

Figure 5-98 MySQL Client session: Assigning user rights

You can check that the privileges have been assigned by using the command:

SHOW GRANTS for user

```

[notes@dyn9-243-89-153 linux]$ mysql -u testuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 34 to server version: 3.23.52-log

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> show grants for testuser@dyn9-243-89-153;
-----
| Grants for testuser@dyn9-243-89-153
|
| GRANT USAGE ON *.* TO 'testuser'@'dyn9-243-89-153' IDENTIFIED BY PASSWORD '7dc
|
1 row in set (0.00 sec)

mysql> show grants for testuser@localhost;
-----
| Grants for testuser@localhost
|
| GRANT USAGE ON *.* TO 'testuser'@'localhost' IDENTIFIED BY PASSWORD '7dcda0d57
|
1 row in set (0.00 sec)

mysql>

```

Figure 5-99 MySQL Client session: Displaying user rights

If you would like, you can go ahead and run a quick test to verify that testuser now has the correct rights. We demonstrate much the same in the next section, when we create the database and tables we will be working with.

```

[notes@dyn9-243-89-153 notes]$ mysql -u testuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 39 to server version: 3.23.52

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> use test
Database changed
mysql> create table test_table (
-> ID int not null auto_increment primary key,
-> test_data text
-> );
Query OK, 0 rows affected (0.00 sec)

mysql> insert into test_table set
-> test_data = "my first test data";
Query OK, 1 row affected (0.00 sec)

mysql> select * from test_table;
+-----+-----+
| ID | test_data |
+-----+-----+
| 1 | my first test data |
+-----+-----+
1 row in set (0.00 sec)

mysql> _

```

Figure 5-100 MySQL Client session: Creating a table, inserting data into the table, and displaying the data in the table

## Creating a database

Creating a database is a simple matter. The following command will create a database for you:

```
mysqladmin -u testuser -p create sample_database
```

Alternately, you can use the mysql client method:

```
mysql> CREATE DATABASE sample_database
```

```
[notes@dyn9-243-89-153 notes1$ mysql -u testuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 48 to server version: 3.23.52

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> create database ADMINISTRATOR;
Query OK, 1 row affected (0.00 sec)

mysql> show databases;
+-----+
| Database |
+-----+
| ADMINISTRATOR |
| mysql |
| test |
+-----+
3 rows in set (0.00 sec)

mysql> use ADMINISTRATOR;
Database changed
mysql> _
```

*Figure 5-101 MySQL Client session: Creating a database and verifying its existence on the system*

If you later find that you would like to delete the database from the system, use the command:

```
mysql> DROP DATABASE <name>
```

## Creating a table

Now that you have a database, you need a table to manage and organize the data. The syntax is:

```
mysql> CREATE TABLE <name> (
-> <column1> <type> <flags>
-> <column2> <type> <flags>
-> <column3> <type> <flags>
and so on... ->);
```

In this example, we demonstrate creating a table named EMPLOYEE. We won't worry about normalizing our tables. For columns we will have: EMPNO, FIRSTNAME, MIDINIT, LASTNAME, WORKDEPT, PHONENO, HIREDATE, SEX, EDLEVEL, BONUS, COMMISSION, and SALARY.

```
mysql> USE ADMINISTRATOR;
Database changed
mysql> CREATE TABLE EMPLOYEE (
-> EMPNO CHAR(20) NOT NULL PRIMARY KEY,
-> FIRSTNAME TINYTEXT,
-> MIDINIT CHAR,
-> LASTNAME CHAR(15),
-> WORKDEPT CHAR(15),
-> PHONENO CHAR(15),
-> HIREDATE DATE,
-> SEX CHAR,
-> EDLEVEL TINYTEXT,
-> BONUS DECIMAL(10,2),
-> COMMISSION DECIMAL(10,2),
-> SALARY DECIMAL(15,2)
-> );
Query OK, 0 rows affected (0.00 sec)

mysql> SHOW TABLES;
+-----+
| Tables_in_ADMINISTRATOR |
+-----+
| EMPLOYEE                 |
+-----+
1 row in set (0.00 sec)
```

Figure 5-102 MySQL Client session: Creating a table and verifying its existence

We can verify the characteristics of the table by using the command:

```
describe <table>
```

```
mysql> USE ADMINISTRATOR;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> DESCRIBE EMPLOYEE;
+-----+-----+-----+-----+-----+-----+
| Field      | Type          | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| EMPNO      | varchar(20)   |      | PRI |          |       |
| FIRSTNAME  | tinytext      | YES  |     | NULL    |       |
| MIDINIT    | char(1)       | YES  |     | NULL    |       |
| LASTNAME   | varchar(15)   | YES  |     | NULL    |       |
| WORKDEPT   | varchar(15)   | YES  |     | NULL    |       |
| PHONENO    | varchar(15)   | YES  |     | NULL    |       |
| HIREDATE   | date          | YES  |     | NULL    |       |
| SEX        | char(1)       | YES  |     | NULL    |       |
| EDLEVEL    | tinytext      | YES  |     | NULL    |       |
| BONUS      | decimal(10,2) | YES  |     | NULL    |       |
| COMMISSION | decimal(10,2) | YES  |     | NULL    |       |
| SALARY     | decimal(15,2) | YES  |     | NULL    |       |
+-----+-----+-----+-----+-----+-----+
12 rows in set (0.00 sec)

mysql>
```

Figure 5-103 MySQL Client session: Displaying the table format

If you want to delete the table, use:

```
DROP TABLE tablename;
```

If you want to rename the table, use:

```
RENAME TABLE table TO new_tablename;
```

If you want to change the format of a column or remove a column, refer to the MySQL Reference Manual regarding ALTER

## Configuring ODBC

ODBC stands for Open Database Connectivity. It is an open standard for an application program interface (otherwise known as API) used to access a database. Each database vendor will need to have an ODBC driver that will allow communication from the API to the database. This allows for the abstraction of the specific database programming language so that you now have flexibility in the number of databases that can be supported. More concisely, you only need to know the language of the ODBC API in order to communicate to any database product that has an ODBC driver.

### ***MyODBC***

The ODBC driver we will using is MyODBC, which is the ODBC driver from MySQL. All that is required is to install the driver. The essence of this package comes in the form of a shared library named libmyodbc.so. This library will act as the translation key when it is called on by an ODBC manager.

Since it is a static library, there isn't anything in the way of configuration necessary for MyODBC.

### ***unixODBC***

An ODBC manager is the actual interface between us and the database. This program provides the point of communication that we can interact with using the language as defined by the ODBC API. The ODBC manager then figures out the type of database that is being targeted and handles communication with the database by using the driver we specify in configuration. The ODBC manager we are using is called unixODBC and as we mentioned earlier, it is provided with most distributions of Linux.

The ODBC driver for MySQL needs to be defined in the odbcinst.ini. As you can see in our installation, the PostgreSQL section is defined as well. Here you will want to:

1. Comment out the PostgreSQL section as it is not being used (any line that begins with a # is commented out and will be ignored).
2. Make sure the section that defines the MySQL driver is defined and not commented out.
3. Make sure the file libmyodbc.so exists and is located where the Driver parameter indicates.



```
[root@suplab03 etc]# cat odbcinst.ini
# Example driver definitions
#
#
# Included in the unixODBC package
#[PostgreSQL]
#Description      = ODBC for PostgreSQL
#Driver           = /usr/lib/libodbcpsql.so
#Setup            = /usr/lib/libodbcpsqlS.so
#FileUsage        = 1

# From the MyODBC package
[MySQL]
Description      = ODBC for MySQL
Driver           = /usr/lib/libmyodbc.so
FileUsage        = 1
[root@suplab03 etc]#
```

Figure 5-104 Telnet session: *odbcinst.ini* example contents

Links are definitions of target databases. We will need to use links to define what database we want to connect to, how we will connect to it, and how we will communicate with the database. The *odbc.ini* defines the links that are available for users to connect to. You can copy the sample *odbc.ini* that is provided with the documentation to the */etc* directory. In our installation, the sample was located at */usr/share/doc/packages/MyODBC/odbc.ini*. It will have some default values, but the necessary configuration information is below:

[Link\_Name]

Driver      driver\_file # driver being used to access the database. Refer to the driver being used in the *odbcinst.ini* described above.

Server      server\_the\_db\_is\_on

DB          database\_name

Port        3306 # port being used. This can be verified by checking the */etc/services* file

```
[notes@dyn9-243-89-153 notes]$ more /etc/odbc.ini
[adminDB]
Driver      = /usr/local/lib/libmyodbc.so
SERVER      = 9.243.89.153
PORT        = 3306
Database    = ADMINISTRATOR

[notes@dyn9-243-89-153 notes]$ _
```

Figure 5-105 Telnet session: Verifying example *odbc.ini* contents

Once you are finished configuring the /etc/odbc.ini, go ahead and copy it to a file named .odbc.ini in the home directory of the user who will be connecting. Each user can reference this file with ~/.odbc.ini. In this example, you would issue the following commands to copy the file (assuming the Domino user is notes).

```
su - notes
cp /etc/odbc.ini ~/.odbc.ini
```

## Testing ODBC

We can test our configuration by connecting to the sample database we created earlier. The isql program allows us to test ODBC connectivity. The syntax is:

```
isql <odbc.ini reference> <user> <password>
```

Here we use the -v option to get a verbose output in case something goes wrong.

```
[notes@dyn9-243-89-153 notes]$ more /etc/odbc.ini
[adminDB]
Driver      = /usr/local/lib/libmyodbc.so
SERVER      = 9.243.89.153
PORT        = 3306
Database    = ADMINISTRATOR

[notes@dyn9-243-89-153 notes]$ cp /etc/odbc.ini ~/.odbc.ini
[notes@dyn9-243-89-153 notes]$ isql -v adminDB testuser testpass
+-----+
| Connected! |
+-----+
| sql-statement |
+-----+
| help [tablename] |
+-----+
| quit |
+-----+
SQL> select database(<)
+-----+
| database(<) |
+-----+
| ADMINISTRATOR |
+-----+
1 rows affected
SQL>
```

Figure 5-106 Telnet session: Testing ODBC connectivity

Remember, you may run into issues where connectivity is denied based on the host or user/host combination. It is important to remember, when creating a user record, that each host/user combination needs to be *explicitly* listed in the user table or the MySQL database, even if it is just the difference between the hostname and the fully qualified name. Following is a sample entry for adding a user named `usera` on `samplehost.domain.com` which would give connectivity to the whole RDBMS.

```
GRANT USAGE ON *.* TO usera@samplehost.domain.com identified by 'password';
FLUSH PRIVILEGES;
```

## Testing Domino connectivity to the database

Now that we know ODBC works, we can test Domino connectivity by running `dctest`. This binary is located in the binaries directory. By default it will be installed in the `/opt/lotus/notes/latest/linux` directory. Make sure that you are running this test as the notes user.

As mentioned earlier, `dctest` will require the library `libodbc.so`. The `unixODBC` install puts a `libodbc.so.1.x.x` file in the `/usr/lib` directory. Make sure there is a symbolic link named `libodbc.so` in the Domino binaries directory that has the `/usr/lib/libodbc.so.1.x.x` file as the target. The command for this is:

```
ln -s /usr/lib/libodbc.so.1.x.x /opt/lotus/notes/latest/linux/libodbc.so
```

After this is installed, run `dctest`. The command is `./dctest` if you are presently in the binary directory. When the menu appears, select Option 3 for ODBC.

```
Inotes@dyn9-243-89-153 linux1$ pwd
/data/rnext/lotus/notes/latest/linux
Inotes@dyn9-243-89-153 linux1$ ./dctest

Lotus Connector Server Connection Verification Test
Copyright 2001 Lotus Development Corporation
-----

This utility will verify connectivity from this
machine to the selected type of server.

At the prompt, enter the number of the test
you would like to run, or enter 0 to exit.

0 - Exit this program
1 - Lotus Notes
2 - Oracle Server
3 - ODBC
6 - DB/2
8 - Oracle8 Server

Run test number: [0] 3
```

Figure 5-107 Telnet session: Testing Domino to ODBC connectivity with `dctest`

Enter the same data that we had used when we tested the ODBC data source with `isql`. The `dctest` should indicate a successful connection.

```
Run test number: [0] 3

ODBC Connection Verification
Copyright 2000 Lotus Development Corporation
-----
This utility will verify connectivity from this machine to the
specified ODBC data source.

At the prompts, enter a valid ODBC data source, username, and password

loaded library libodbc.so
  Data Source: : adminDB
    User Id: : testuser
    Password: : testpass
  Driver Details: [N]
Attempting to connect to adminDB...

Successfully Connected.

Try Again: [N]
```

Figure 5-108 Telnet session: Results of dctest

### 5.4.5 Setup and configuration of the Notes/Domino application

Notes/Domino now allows you to integrate backend data with much less effort than in previous versions. In Domino 6, configuration is done within the database itself. The steps are:

1. Configure connectivity with a Data Connection Resource and the database properties.
2. Link the data to fields in the database.

And you're done. As you can tell, linking your Domino database to an external source is a pretty simple affair.

#### **Configure connectivity with a Data Connection Resource and the database properties**

In this section we describe how to:

1. Make the Notes database
2. Create a Data Connection Resource
3. Allow the Notes database to use an external database

First we will need to create a database to serve as our sample. We begin by starting the Domino 6 Designer from a Windows 2000 workstation.

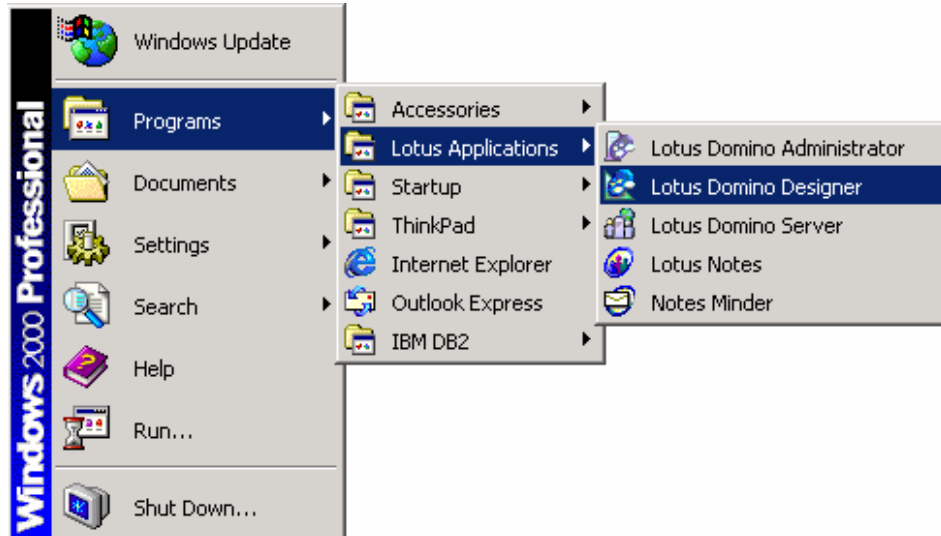


Figure 5-109 Start Domino Designer

## Making the Notes database

Once the Designer client has started you will be presented with a start page. Choose **Create a new database**.

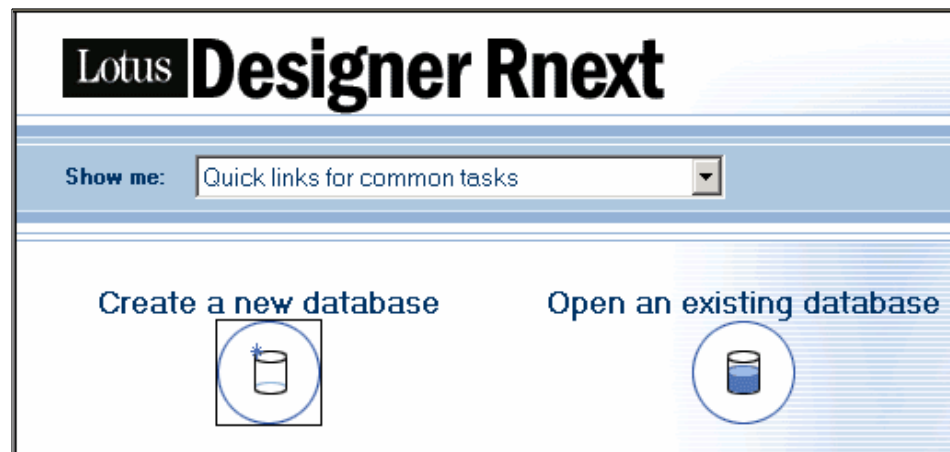


Figure 5-110 Domino Designer: Creating a new database

The first step is to create a new database. We used a template created for this example called MySQLEmp. This database will house Employee information.

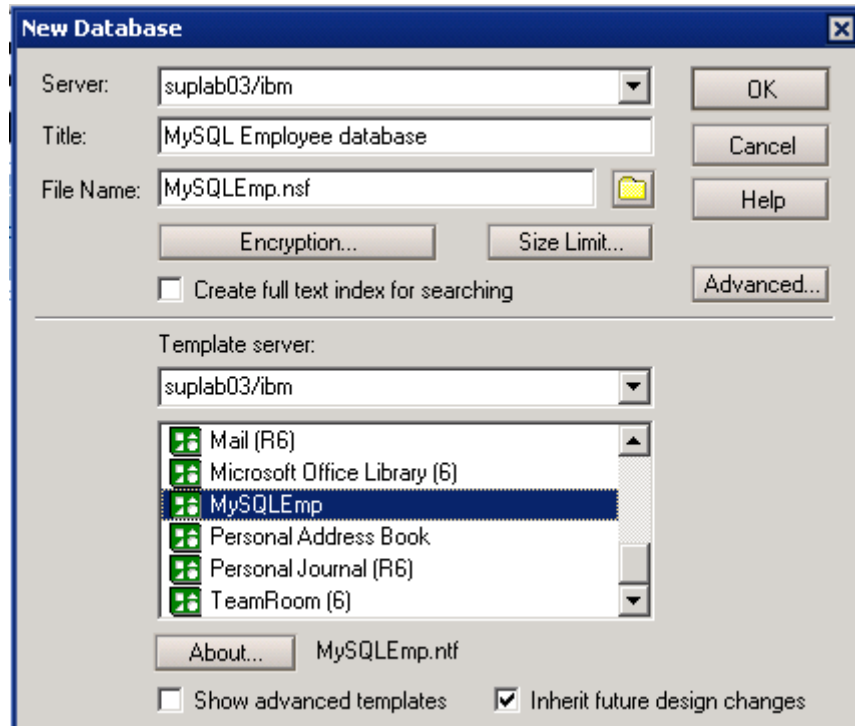


Figure 5-111 Domino Designer: New Database

For the server, enter the name of the Domino 6 server where the Domino for Linux installation is housed.

Choose a name for your application. We chose MySQL Employee database. The Domino 6 template for this application is named MySQLEmp.

## Creating a Data Connection Resource

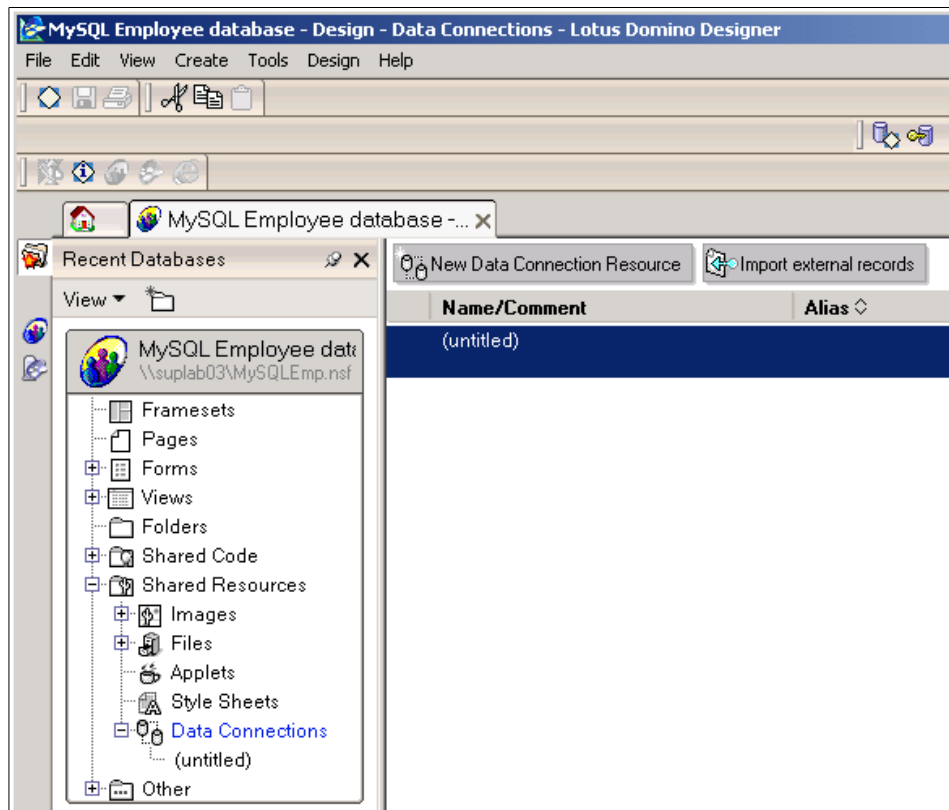
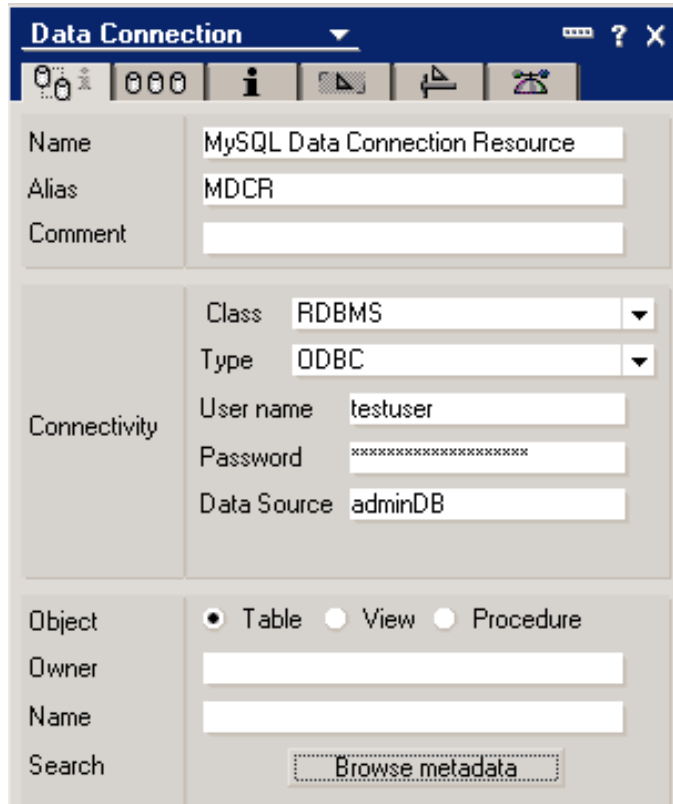


Figure 5-112 Domino Designer - Data Connection

The first part of configuring the application to use external data is to set up connectivity to the MySQL database. Then, point to the appropriate table Domino will use. These two steps are handled in the Data Connection Resource or DCR. You can find this information under Shared Resources/Data Connections.

In the left-hand pane of Designer under Recent Databases, select **Shared Resources -> Data Connections -> New Data Connection Resources**.

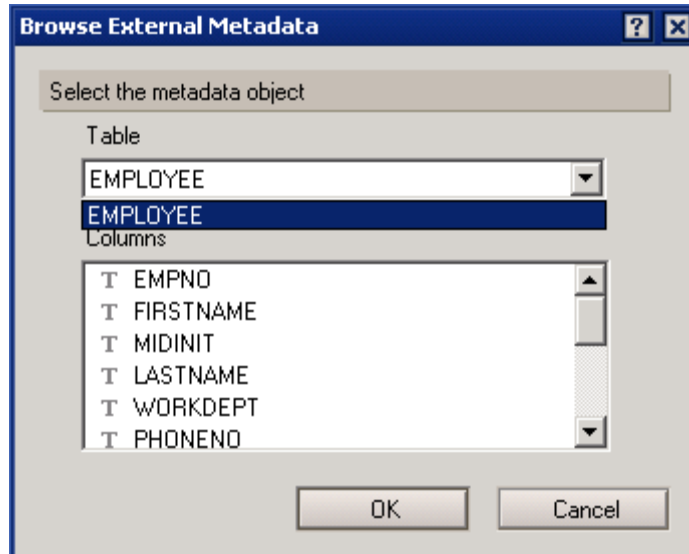


<b>Data Connection</b>	
Name	MySQL Data Connection Resource
Alias	MDCR
Comment	
Connectivity	Class: RDBMS
	Type: ODBC
	User name: testuser
	Password: xxxxxxxxxxxxxxxx
	Data Source: adminDB
Object	<input checked="" type="radio"/> Table <input type="radio"/> View <input type="radio"/> Procedure
Owner	
Name	
Search	<input type="button" value="Browse metadata"/>

Figure 5-113 Domino Designer: DB2 Data Connection

On the Data Connection dialog box, enter a name of MySQL Data Connection Resource. You can put the alias MDCR in the Alias field since the name is so long. For Class and Type enter RDBMS and ODBC respectively. For User Name enter testuser or the appropriate account for your MySQL installation, and supply the password in the Password field. For Database enter adminDB, then click **Browse Metadata**.





*Figure 5-114 Domino Designer: Choosing possible tables to use in our Data Connection*

In the Browse External Metadata dialog box, select EMPLOYEE for Table, then choose **OK** to close the dialog.

Data Connection	
Name	MySQL Data Connection Resource
Alias	MDCR
Comment	
Connectivity	Class: RDBMS
	Type: ODBC
	User name: testuser
	Password: *****
	Data Source: adminDB
Object	<input checked="" type="radio"/> Table <input type="radio"/> View <input type="radio"/> Procedure
Owner	
Name	EMPLOYEE
Search	<input type="button" value="Browse metadata"/>

Figure 5-115 Domino Designer: Completed Data Connection

Figure 5-115 is an example of what your data connection should look like.

## Allowing the Notes database to use an external database

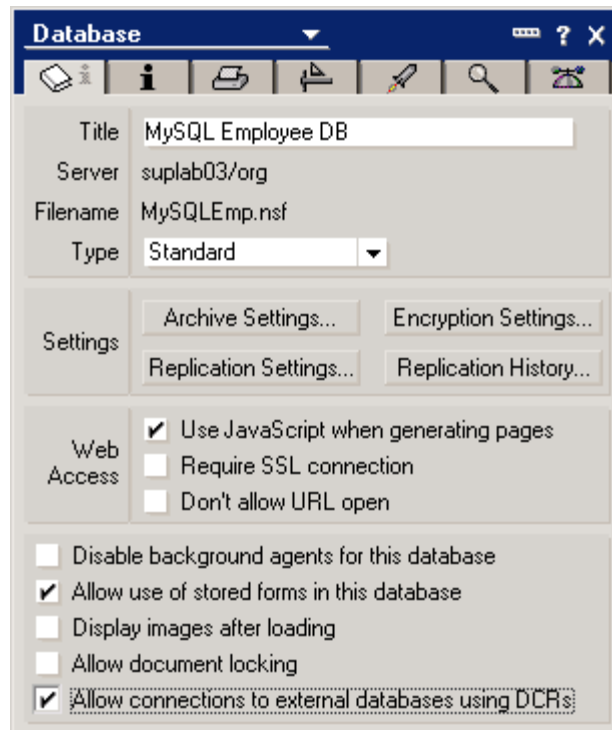


Figure 5-116 Database Properties: Allowing the use of external databases

Open the Database properties dialog box (from the main menu, select **File -> Database -> Properties**). On the first tab, select the “Allow connections to external databases using DCRs” checkbox.

## Link the data to fields in the database

The screenshot displays the Lotus Domino Designer interface for editing a form named 'EmployeeForm - Form x'. The left-hand navigation pane shows the project structure for 'MySQL Employee data' (located at \\suplab03\MySQLEmp.nsf). The 'Forms' folder is selected, showing a list of items including Framesets, Pages, Forms, Views (EmployeeNumbersView, WorkDeptView), Folders, Shared Code, Shared Resources, and Other. The main editor area shows the form design, which has a yellow header with the text 'Lotus Employee Lookup'. Below the header, there are eight rows, each representing a form field. Each row has a label on the left and a text input field on the right. The fields are: Employee Number (linked to EMPNO), First Name (linked to FIRSTNAME), Middle Initial (linked to MIDINIT), Last Name (linked to LASTNAME), Work Department (linked to WORKDEPT), Phone Extension (linked to PHONENO), Hiredate (linked to HIREDATE), and Sex (linked to SEX). Each input field has a small 'T' icon next to it, indicating a text field.

Lotus Employee Lookup	
Employee Number:	<input type="text" value="EMPNO"/>
First Name:	<input type="text" value="FIRSTNAME"/>
Middle Initial:	<input type="text" value="MIDINIT"/>
Last Name:	<input type="text" value="LASTNAME"/>
Work Department:	<input type="text" value="WORKDEPT"/>
Phone Extension:	<input type="text" value="PHONENO"/>
Hiredate:	<input type="text" value="HIREDATE"/>
Sex:	<input type="text" value="SEX"/>

Figure 5-117 Domino Designer: Employee Form

Next, select the icon for **Forms** in the left-hand navigation pane, then select **EmployeeForm**.

Set the default Data Connection on the Form properties. This is on the defaults tab (the second tab). When you configure a field to use an external data source, the default information for the data connection is supplied automatically. You can later select another Data Connection Resource if you want to.

The screenshot shows the 'Form' properties dialog box in Domino Designer. The dialog has a title bar 'Form' and a standard Windows toolbar. It is divided into several sections:

- On Create:** Contains two checkboxes: 'Formulas inherit values from selected document' (unchecked) and 'Inherit entire selected document into rich text field:' (unchecked).
- On Open:** Contains two checkboxes: 'Automatically enable Edit Mode' (unchecked) and 'Show context pane' (unchecked).
- On Close:** Contains one checkbox: 'Present mail send dialog' (unchecked).
- On Web Access:** Contains a 'Content type' section with three radio buttons: 'Notes' (selected), 'HTML' (unchecked), and 'Other' (unchecked). Below this is a 'Character set' dropdown menu set to 'Default'. There is also a checkbox 'Generate HTML for all fields' (unchecked). At the bottom of this section are three color pickers for 'Active link' (red), 'Unvisited link' (blue), and 'Visited link' (purple).
- Data Source Options:** Contains a 'Browse' button, a 'Default data connection' text box with the value 'MySQL Data Connection R...', and a 'Default metadata object' text box with the value 'EMPLOYEE'.

Figure 5-118 Domino Designer: EmployeeForm form properties

Set the default Data Connection on the form properties dialog. This is on the defaults tab (the second tab). When you configure a field to use an external data source, the default information for the data connection is supplied automatically. You can later select another Data Connection Resource if you want to.

The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'EMPNO'. The 'Type' is 'Text' and 'Editable'. Under the 'Type' section, 'Allow multiple values' and 'Compute after validation' are unchecked, while 'External data source' is checked. The 'Style' section has 'Notes style' selected. The 'Size' section shows 'Width' as 1.000" and 'Height' as 0.250", both set to 'Fixed'. The 'Tab Key' section shows 'Position in tab order' as 0, with 'Give field initial (default) focus' unchecked. The 'Data Source Options' section includes a 'Browse' button, 'External field name' (empty), 'Metadata object name' set to 'EMPLOYEE', and 'Data connection resource' set to 'MySQL Data Connection R'. At the bottom, 'Store data locally' is unchecked, and 'Data field' is selected under the radio buttons.

Name		EMPNO	
Type	Text	Editable	
<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source			
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's baseline with paragraph's		
Size	Width	1.000"	Fixed (Size)
	Height	0.250"	Fixed
Tab Key	Position in tab order 0 <input type="checkbox"/> Give field initial (default) focus		
Data Source Options		Browse	
External field name			
Metadata object name		EMPLOYEE	
Data connection resource		MySQL Data Connection R	
<input type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field			

Figure 5-119 Domino Designer: EMPNO field properties

Double click on the **EMPNO** field to open the field properties dialog. Enable “External data source” by checking that box. Next to “Data Sources Options” click **Browse**.

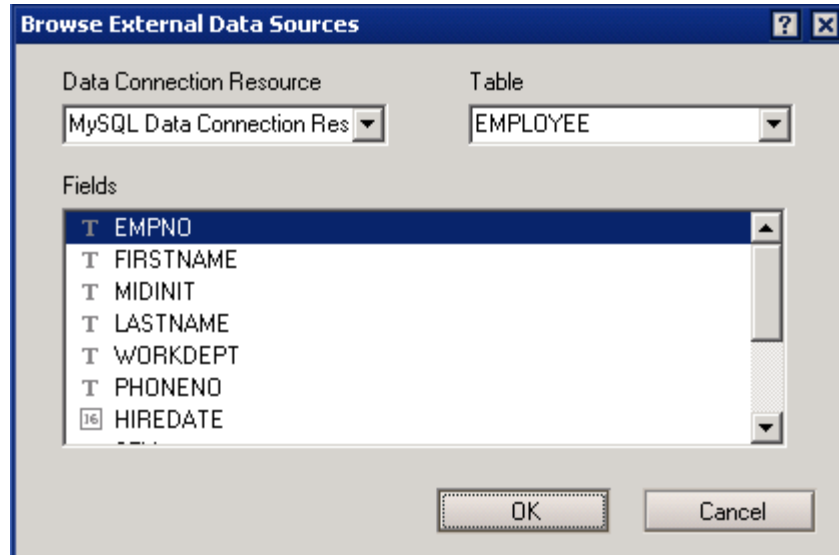


Figure 5-120 Domino Designer: Browse MySQL EMPNO

For “Data Connection Resource” select **MySQL Data Connection Resource**.  
For “Table” select **EMPLOYEE**. For “Columns” select **EMPNO**, then click **OK**.

**Field**

Name:

Type:

☐ Allow multiple values

☐ Compute after validation

☒ External data source

Style: ☒ Notes style ☐ Native OS style

☐ Align control's baseline with paragraph's

Size: Width  Fixed (Size)

Height  Fixed

Tab Key: Position in tab order

☐ Give field initial (default) focus

Data Source Options

External field name

Metadata object name

Data connection resource

☒ Key field ☐ Data field

Figure 5-121 Domino Designer: EMPNO field properties

On the very bottom of the properties dialog, select **Key Field**. Notice the Store Locally checkbox has disappeared. This is because Key fields *must* be stored locally.



The screenshot shows the 'Field' properties dialog in Domino Designer. The 'Name' field is set to 'FIRSTNME'. The 'Type' is 'Text' and 'Editable' is checked. Under 'Style', 'Notes style' is selected. Under 'Size', 'Width' is 1.000" and 'Height' is 0.250". Under 'Tab Key', 'Position in tab order' is 0. Under 'Data Source Options', 'Browse' is clicked. The 'External field name' is 'FIRSTNAME', 'Metadata object name' is 'EMPLOYEE', and 'Data connection resource' is 'MySQL DCR'. The 'Data field' radio button is selected.

Name	FIRSTNME	
Type	Text	Editable
	<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source	
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's baseline with paragraph's	
Size	Width 1.000"	Fixed (Size)
	Height 0.250"	Fixed
Tab Key	Position in tab order 0	
	<input type="checkbox"/> Give field initial (default) focus	
Data Source Options	Browse	
External field name	FIRSTNAME	
Metadata object name	EMPLOYEE	
Data connection resource	MySQL DCR	
	<input type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field	

Figure 5-122 Domino Designer: FIRSTNME field properties

Close the properties dialog and double-click the **FIRSTNME** field to open the properties dialog for that field. Enable “External data source,” next to “Data Source Options,” select **Browse**.

Almost exactly as we did before, for “Data Connection Resource” select **MySQL Data Connection Resource**. For “Table” select **EMPLOYEE**. For “Columns” select **FIRSTNAME**, then click **OK**.

We leave the Data field radio button selected. This will store this information solely in the MySQL database.

Field	
Name	LASTNAME
Type	Text Editable
<input type="checkbox"/> Allow multiple values <input type="checkbox"/> Compute after validation <input checked="" type="checkbox"/> External data source	
Style	<input checked="" type="radio"/> Notes style <input type="radio"/> Native OS style <input type="checkbox"/> Align control's baseline with paragraph's
Size	Width: 1.000" Fixed (Size) Height: 0.250" Fixed
Tab Key	Position in tab order: 0 <input type="checkbox"/> Give field initial (default) focus
Data Source Options	Browse
External field name	LASTNAME
Metadata object name	EMPLOYEE
Data connection resource	MySQL Data Connection R
<input checked="" type="checkbox"/> Store data locally <input type="radio"/> Key field <input checked="" type="radio"/> Data field	

Figure 5-123 Domino Designer: LASTNAME field properties

Close the properties dialog and double click the **LASTNAME** field to open the properties dialog for that field. Enable “External data source;” next to “Data Source Options,” select **Browse**.

Browse for the appropriate field, as you have done previously. Back on the properties dialog, enable “Store data locally.” This information will now be stored on the MySQL database and Notes database. This allows us to see the data in a view.

For all remaining fields in the EmployeeForm, repeat the steps to enable “External data source” and browse the “Data source options,” to ensure you select the correct MySQL column for the field you are working with. *Do not* enable “Store data locally” for any additional fields.

Once you've completed the modifications for each field, press Esc to close the form and select **Yes** to save the form.

## Testing

Open the database and you can see the database has no documents.

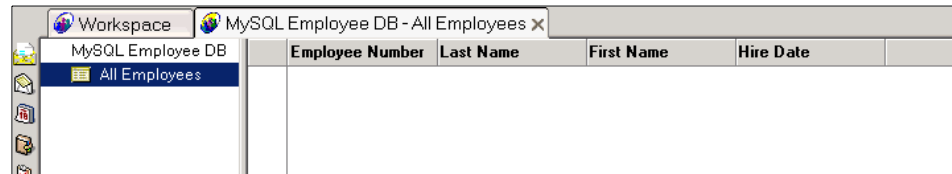


Figure 5-124 Lotus Notes Client: Database Open DB2EMP

Notice there is no data in the database. The new database is empty at this point.

**Note:** If you want to import data see the Lotus Domino Designer 6 help database, document “Importing data from an external database into an application,” for more information

```
[root@dyn9-243-89-153 notes]# mysql -u testuser -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 30 to server version: 3.23.52-log

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> use ADMINISTRATOR
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> SELECT * FROM EMPLOYEE;
Empty set (0.00 sec)

mysql> _
```

Figure 5-125 MySQL client session: Verifying no data in the EMPLOYEE table

We can check to make sure that there is no data in the EMPLOYEE table by issuing a simple select statement.

Next we will create a form and put some data in the database.

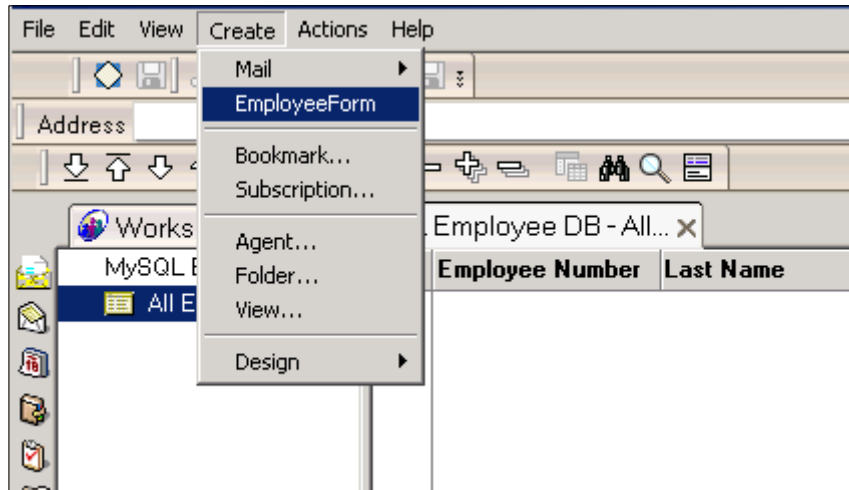


Figure 5-126 Notes client: Creating a form in MySQL Employee DB

From the menu bar choose **Create -> EmployeeForm**.

 A screenshot of the Lotus Employee Lookup form. The form has a yellow header with 'Lotus' and 'Employee Lookup' text, and the IBM logo. Below the header is a table with various fields filled out:
 

Employee Number:	mmm10982
First Name:	Michael
Middle Initial:	J
Last Name:	Lee
Work Department:	Software
Phone Extension:	x23456
Hiredate:	12-25-00
Sex:	M
Education Level:	Bachelor of Science
Bonus:	15.00
Commision:	100.00
Salary:	30000.59

 At the bottom of the form, there is a logo for 'e-business software' and the text: 'IT'S A DIFFERENT KIND OF WORLD. YOU NEED A DIFFERENT KIND OF SOFTWARE.'

Figure 5-127 Notes Client: Filling out the EmployeeForm

Fill out the form and save it. At the very minimum, the Employee Number field will have to have a value since it was configured to not allow a null value.

Save and close the form.

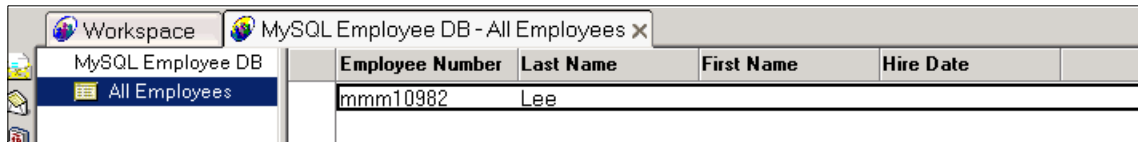


Figure 5-128 Notes Client: Verifying data in the All Employees view

Switch to the All employees view. Notice the view only displays the LASTNAME and the EMPNO fields. This is because they are the only fields stored locally.

Go back to the database and you will notice that the table has been updated.

```

+-----+-----+-----+-----+-----+-----+-----+
| WORKDEPT | varchar(15) | YES | | NULL | | |
| PHONENO  | varchar(15) | YES | | NULL | | |
| HIREDATE  | date       | YES | | NULL | | |
| SEX      | char(1)    | YES | | NULL | | |
| EDLEVEL  | tinytext   | YES | | NULL | | |
| BONUS    | decimal(10,2) | YES | | NULL | | |
| COMMISSION | decimal(10,2) | YES | | NULL | | |
| SALARY   | decimal(15,2) | YES | | NULL | | |
+-----+-----+-----+-----+-----+-----+-----+
12 rows in set (0.00 sec)

mysql> SELECT * FROM EMPLOYEE;
+-----+-----+-----+-----+-----+-----+-----+
| EMPNO  | FIRSTNAME | MIDINIT | LASTNAME | WORKDEPT | PHONENO | HIREDATE |
| BONUS | COMMISSION | SALARY |
+-----+-----+-----+-----+-----+-----+-----+
| mmm10982 | Michael | J | Lee | Software | x23456 | 2000-12-25 |
| 15.00 | 100.00 | 30000.59 |
+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

mysql>

```

Figure 5-129 MySQL Client session: Verifying Domino inserted the form data

The following SQL command verifies that the information is now stored in the database:

```
select * from EMPLOYEE
```

If you delete the document, you can go back to the database and see that it is deleted from there as well.

```

| SEX      | char(1)      | YES |      | NULL |      |
| EDLEVEL  | tinytext     | YES |      | NULL |      |
| BONUS    | decimal(10,2)| YES |      | NULL |      |
| COMMISSION | decimal(10,2)| YES |      | NULL |      |
| SALARY   | decimal(15,2)| YES |      | NULL |      |
+-----+
12 rows in set (0.00 sec)

mysql> SELECT * FROM EMPLOYEE;
+-----+
| EMPNO    | FIRSTNAME | MIDINIT | LASTNAME | WORKDEPT | PHONENO | HIREDATE |
| BONUS    | COMMISSION | SALARY   |
+-----+
| mmm10982 | Michael   | J       | Lee      | Software | x23456   | 2000-12-25 |
| cience | 15.00     | 100.00  | 30000.59 |
+-----+
1 row in set (0.00 sec)

mysql> SELECT * FROM EMPLOYEE;
Empty set (0.00 sec)

mysql>

```

Figure 5-130 MySQL Client session: Verifying Domino removed the form data

As you can see, when we ran the select statement, the form data is no longer in the database.

That's it! You have successfully used a Domino application to access employee data in a MySQL database. This process can easily be modified to work with production data in a production application.



## Domino as a Web server

In this chapter we describe how to configure a Domino 6 server to work as a Web server.

We discuss in detail several aspects of implementing the HTTP task for Domino 6, which improves the performance and scalability over previous releases. The most beneficial enhancement to the Domino 6 HTTP task is the addition of several security options specific to the HTTP protocol.

## 6.1 Linux Operating System configuration

Considering the temporary nature of connections under the HTTP protocol (each request opens a connection, sends the message, returns the response, and closes the connection), particular care must be taken in configuring the TCP/IP part of the Linux Operating System.

### 6.1.1 Basic recommendation

It is possible that some other HTTP server could be running on your system, like Netscape or Apache. The only precaution is to check if other HTTP daemons are running on the Linux system using the default port 80.

Use the **ps -ef** command and pipe the output to the **grep** command to check this:

```
# ps -ef | grep http
```

**Note:** The UNIX **grep** command searches a file for a pattern. It also reads from the standard input so it can be used in a pipeline command.

You should not see any HTTP-related task running on your system.

Use the **netstat** command to see if any daemons are using port 80:

```
# netstat -an | grep ":80"
```

In this case the command should not have any output. If there are some daemons listening on port 80 you may have output like this:

```
tcp 0 0.0.0.0:80 0.0.0.0:* LISTEN
```

Generally you can have other HTTP processes running on your system, listening on different ports. Running other HTTP systems on the same Linux server is not recommended if you want to have a high performance Domino Web server.

## 6.2 Domino Web server configuration

The configuration of the HTTP server in Domino 6 is a very easy task. Most of the work is done at Domino installation time if you check the options to install the HTTP task.

**Note:** Refer to Chapter 2, “Installing Domino 6 for Linux” on page 83 for information about installing Domino.



If you choose to install the HTTP task, you will find the HTTP name in the Notes.ini file to the ServerTasks entry:

```
ServerTasks=replica,router,update,amgr,adminp,HTTP
```

**Tip:** The content of the Notes.ini file is *not* case sensitive, so there is no problem if the name of the task is written with capitals and the effective name of the binary file is http. Remember that UNIX *is* case sensitive.

## 6.2.1 Settings on a Domino Web server

To change the settings of the Domino Web server, use the following steps:

1. Start the Domino Administrator.
2. Choose the server you want to reconfigure.
3. Choose the **Configuration** tab.
4. Choose **Server -> All Server Documents**.
5. Double-click the Domino server you want to change or select the server and click **Edit Server**.

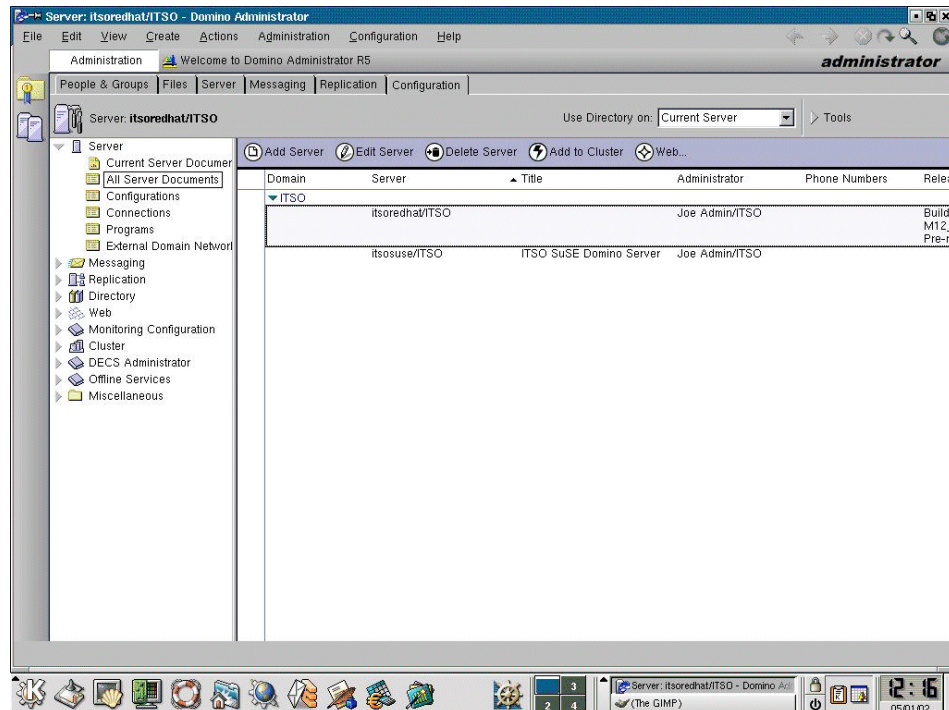


Figure 6-1 Web server configuration

To change the Domino Web server port, click **Ports -> Internet Ports** in the server document. The Web tab should be selected by default.

It is best to use the default port 80 for a non-secure Web server and port 443 for a secure Web server.

**Note:** The secure server will not run until you create a server certificate. See “Setting up SSL on a Domino server” in the Domino 6 Administration online help.

Here you can also choose if you want to allow name and password authentication for clients connecting over TCP/IP; the default is Yes. Also specify whether you will allow anonymous connection over TCP/IP; again, the default is Yes. The same is true for the SSL protocol.

Next, select **Internet Protocols -> HTTP** (see Figure 6-2). In this section, you should make at least the following changes:

- ▶ In the Basic section enter a hostname and enable the “Bind to host name” option if you use a Domino partitioned environment. The parameters “Maximum request over a single connection” and “Number of active threads,” which are discussed later in this chapter, should be set.
- ▶ In the Enable Logging section, enable either log files or Domlog.nsf if you want to create statistics about access to your Web server (for example, by whom, how much, and which pages were accessed). Enabling either type of logging will affect server performance.
- ▶ In the Mapping section, customize the Home URL. It should be either a Notes database or an HTML file.

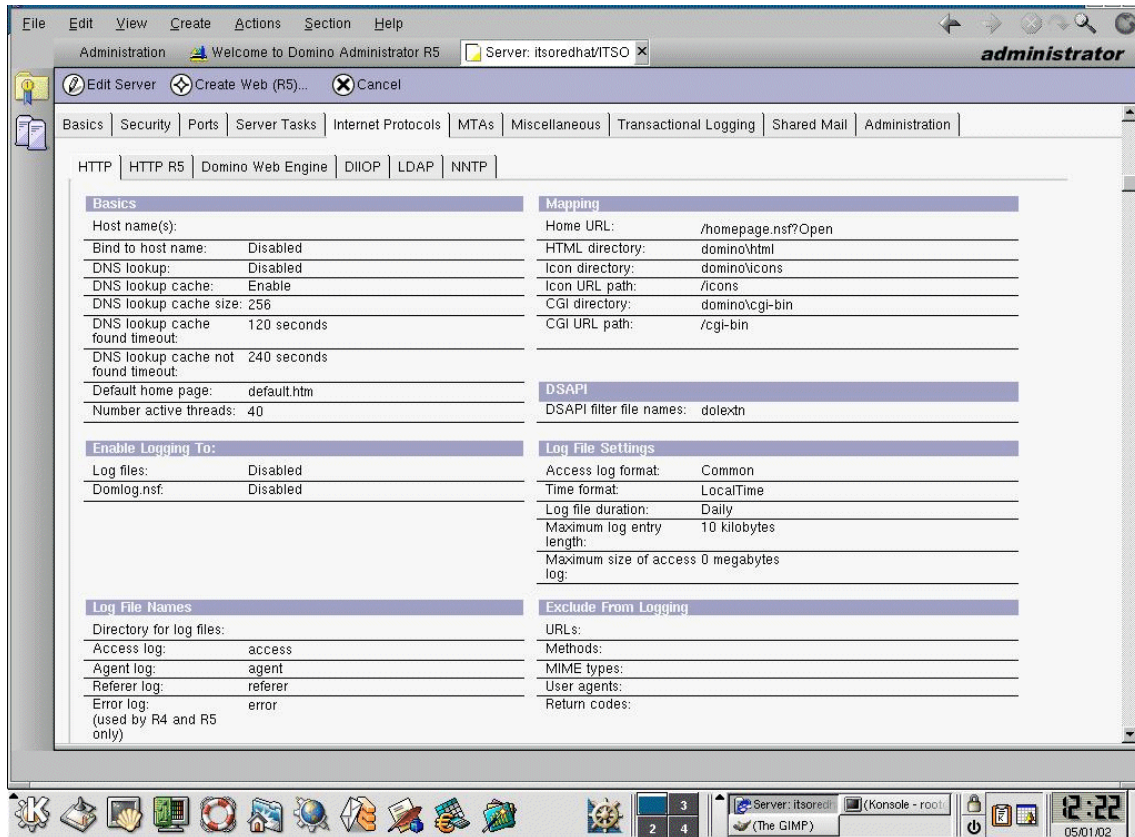


Figure 6-2 Web server Internet protocol specifications

## 6.2.2 Starting, stopping, and refreshing the Domino Web server

There are two ways to start the Domino 6 Web server:

- ▶ Manually, by entering **load http** at the server console
- ▶ Automatically at Lotus Domino 6 start-up, by adding it to the ServerTasks in Notes.ini

You can start only one HTTP task per Domino server; you have to use the Domino partitions feature to have more than one HTTP task running on the Linux server.

To stop the Web server, enter the command **te11 http quit** at the server console, or remove HTTP from the ServerTasks in Notes.ini to stop it from starting at the next restart of the Domino server.

Type the command **tell http restart** at the server console to refresh the Web server, and if you made changes in the Domino Directory related to the HTTP configuration.

**Tip:** You can use the **server -c** Domino command to send a Domino console command from a UNIX prompt. Type **server -c "tell http quit"** to stop the HTTP task from a UNIX prompt.

## 6.3 Security on the Web server

In this section we describe the Web security features in Domino 6. Some new security features were added to Domino 6, including HTTP protocol security options.

### 6.3.1 Internet certificates

Domino certificate authorities can also issue Internet certificates to Notes users, Internet clients, and Internet servers. The Domino certificate authority issues signed X.509 format certificates that uniquely identify the requesting client or server. Internet certificates are required when sending encrypted or electronically signed S/MIME mail messages and when using SSL to authenticate a client or server.

S/MIME is a protocol used by clients to sign mail messages and send encrypted mail messages over the Internet to users of mail applications that also support the S/MIME protocol.

Domino 6 provides native X.509 V3 support along with the Notes certificate.

### 6.3.2 Browsing Domino databases via the Internet

A common security issue is accessing the log.nsf database via a Web browser, for example:

<http://www.itsoredhat.com/log.nsf>

Although the log.nsf database does not contain critical information, a Domino system that allows access to the system log is not secure.

To avoid this you have to change the ACL of the database to either:

- ▶ Default No Access
- or*
- ▶ Anonymous No Access

You have to do one or the other in *each* Domino database in your data directory that must be kept inaccessible to Internet users.

### 6.3.3 Session authentication

A *session* is the time during which a Web client is actively logged on to a server. Session-based name-and-password security includes additional functionality that is not available with basic name-and-password security.

Session-based authentication creates a temporary *cookie* that stores the user name and password on the browser client. As the user traverses the site, responses for name and password are provided by the cookie.

This cookie passes the user credentials for every database within the Domino site, thus alleviating concerns of realm-based authentication.

**Tip:** If you wish to retain realm-specific logins, session-based authentication cannot be used.

Once a user logs in to the Web site, the credentials are passed to every database hosted by the server. The user login information, however, is not shared across virtual hosts or virtual servers; it is based on the host name of the URL request.

You can configure session authentication on the Domino Web Engine tab of the server document, in the HTTP Sessions section. This section is shown in Figure 6-3.

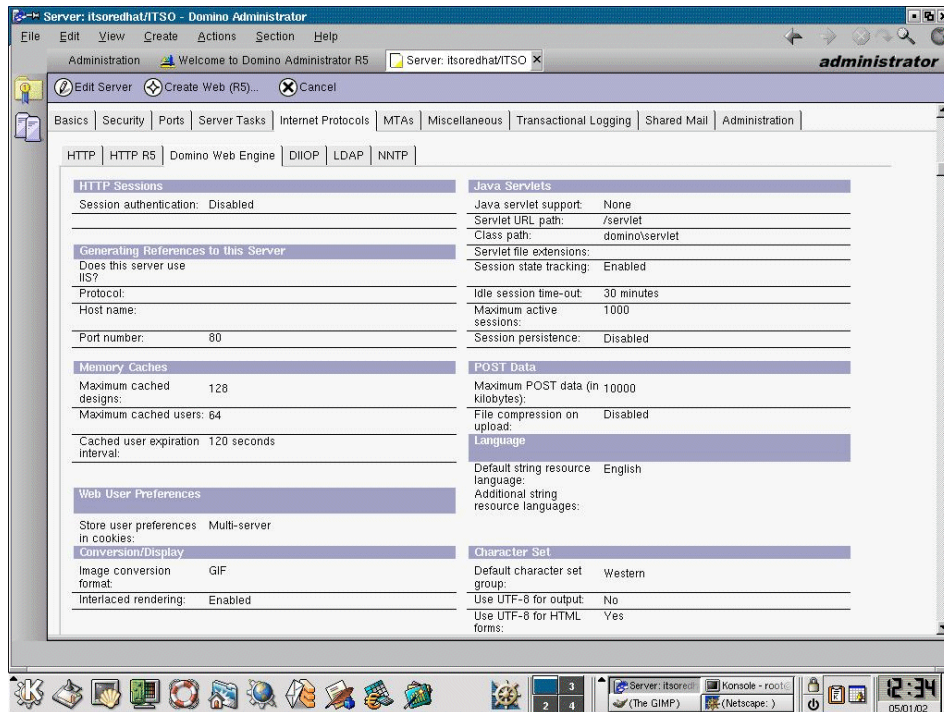


Figure 6-3 Session authentication settings in the server document

With the Session Authentication feature enabled, you can use the following command to find out who is using a Web browser to access your Domino 6 server:

```
> tell http show users
> 04/24/2002 11:00:07 AM There are 2 current HTTP user sessions
04/24/2002 11:00:07 AM User Name IP Address Expires
04/24/2002 11:00:07 AM red book 9.95.35.56 11:29:52 AM
04/24/2002 11:00:07 AM red book 9.95.35.56 11:29:28 AM
```

The session authentication feature is based on the cookie mechanism; it allows a Web server to store pieces of information on the client computer through the Web browser. These pieces of information, known as cookies, are stored on the client machine.

**Tip:** To return the value of a cookie, add a computed field called HTTP\_COOKIE to your form using an empty string as a formula. This field will be populated with the cookie information. You can then use the field HTTP\_COOKIE in other formulas on the page.

### 6.3.4 Domino Web realms

To minimize the need for a Web user to repeatedly supply their password, Domino administrators can set up Web Realms on the server. *Realms*, based on ACLs, are zones of file protection on a Web site.

The browser automatically stores and sends the credentials for pages in the same Realm, so the user can move throughout the Realm after supplying the password just once.

Access the page for setting up Realms by selecting the server document you wish to modify, then choose **Actions -> Create Web R5-> Realm**. The resulting screen is shown in Figure 6-4.

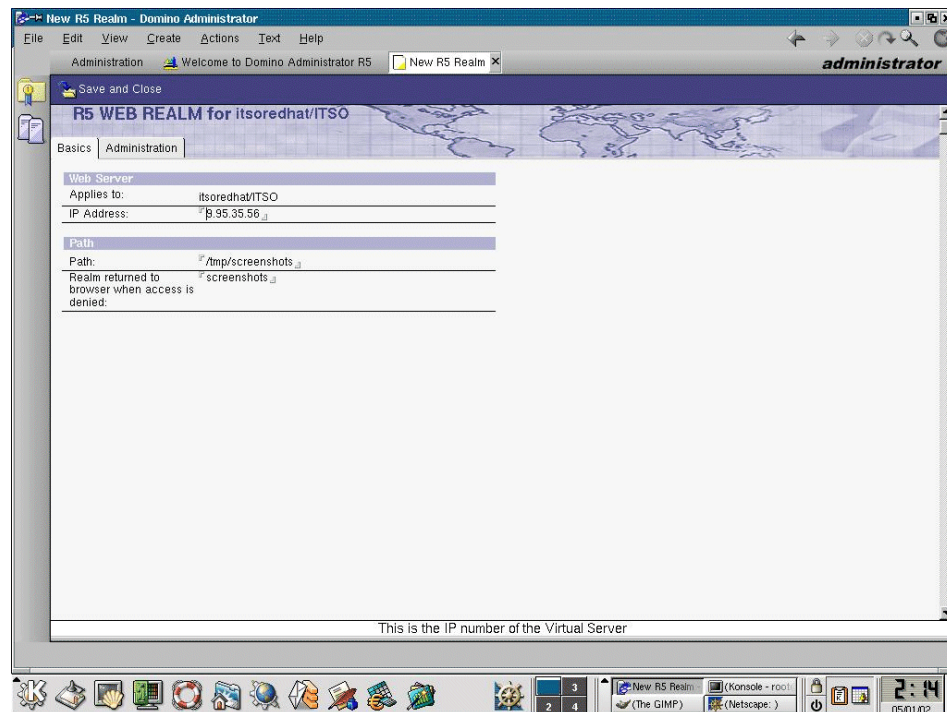


Figure 6-4 Web Realm: Basic setting

Provide information for the Path field to permit user navigation of the directory defined in the Realm.

**Note:** Refer to the Domino Administration 6 Help for additional information about configuring Realms.

### 6.3.5 Domino file protection

In Domino 6, File Protection documents stored in the Domino Directory database are the basis for configuring browser access control to files.

You can enforce file system security for files that browser users can access. For example, for HTML, JPEG, and GIF, you can specify the level of access for these types of files and the names of the users who can access them.

You can apply file system protection on CGI scripts, servlets, and agents. However, the file protection does not extend to other files accessed by the scripts, servlets, or agents. For example, you can apply file protection on a CGI script that restricts access to a group named “Web Admins.” However, if the CGI script executes and opens other files (or causes other scripts to be executed), the File Protection document is not checked to determine whether “Web Admins” has access to these files.

File protection also does not extend to files in the following directories, which contain default image files and Java applets that are used by the HTTP Web server and other applications (for example, mail databases):

- ▶ local/notesdata/domino/java, accessed via Web browser using the path `http://itsoredhat/domjava`
- ▶ local/notesdata/domino/icons, accessed via Web browser using the path `http://itsoredhat/icons`

File system protection does apply, however, to files that access other files, for example, HTML files that open image files. If a user has access to the HTML file but does not have access to the JPEG file that the HTML file uses, Domino does not display the JPEG file when the user opens the HTML file.

You have to consider setting up File Protection documents for each directory Web users are able to access. There is no file protection for an upgraded or new Domino 6 server until you create File Protection documents.

You do this by choosing **Actions -> Create Web R5-> File Protection**. The resulting screen is shown in Figure 6-5.



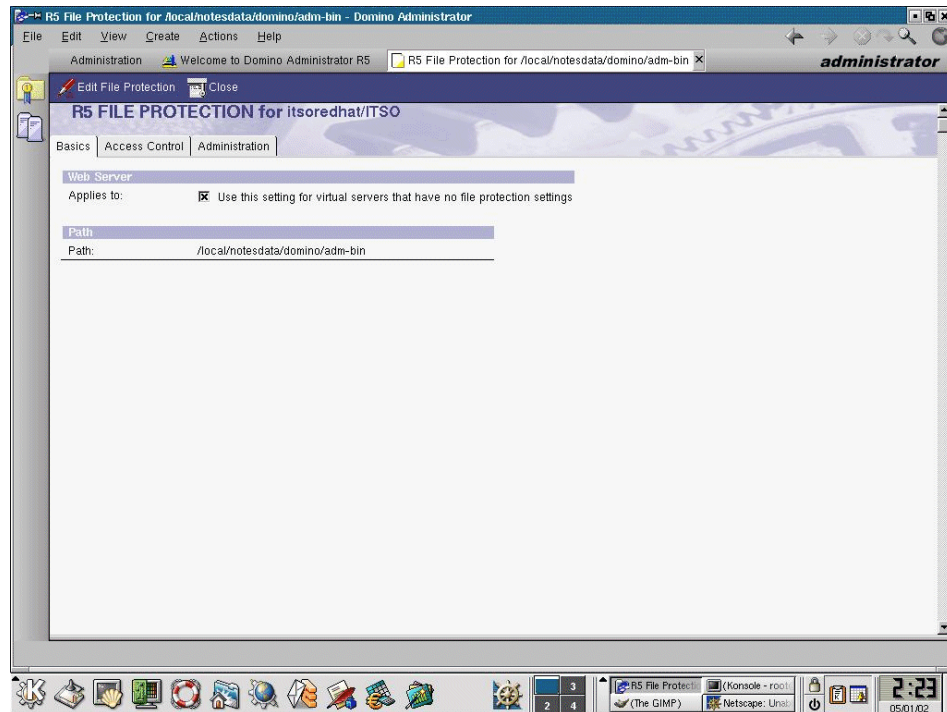


Figure 6-5 File Protection: Basic setting

The ability to set file protection might be needed in mixed environments, where you have some data in the Notes databases and other data in text files. These protection settings apply to all Web servers on a Lotus Domino 6 server.

Y

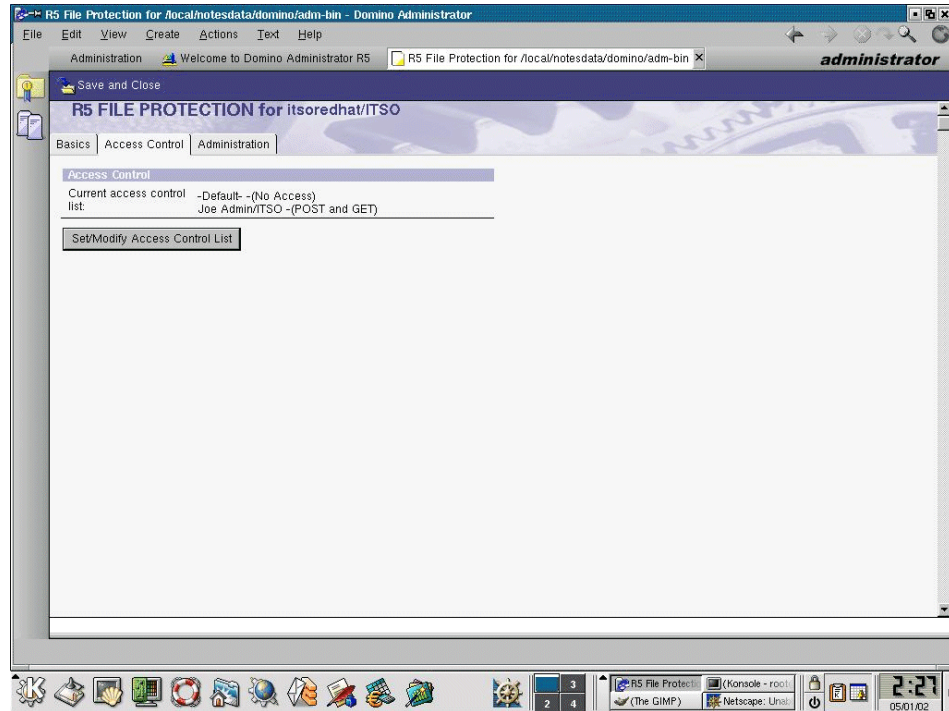


Figure 6-6 Access control for file permissions

You can only grant access to users specified in the server's Domino Directory, even if you are allowed to enter any user. You assign these permissions by clicking **Set/Modify Access Control List** in the Access Control tab.

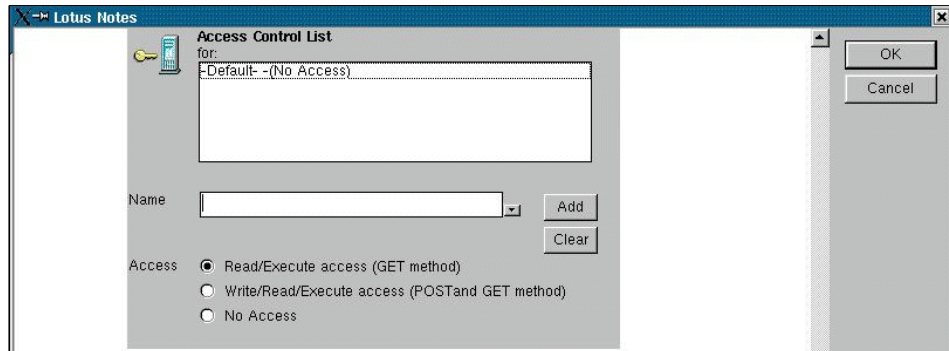


Figure 6-7 Access Control List for file protection

There are three access levels you can assign to a user:

- ▶ Read/Execute access (GET method)
- ▶ Write/Read/Execute access (POST and GET method)
- ▶ No Access

In the Name field, specify the user name by typing or by using the Domino Directory lookup. After assigning the appropriate access permission, click **OK** to apply this user to the Access Control List. To remove a user, click the name and click **Clear**.

### 6.3.6 HTTP protocol security

Domino 6 is better equipped to fend off cyber attacks than Domino R5. Several new protocol-related security settings have been added to the Server document under the Internet Protocols -> HTTP tab. These new settings are designed to discourage attacks that probe for buffer overflows or request parsing errors.

The new settings for HTTP protocol security are:

- Maximum URL Length
- Maximum Number of URL Path Segments
- Maximum Number of Request Headers
- Maximum Size of Request Headers
- Maximum Size of Request Content

*Maximum URL length* is the URL length allowed to be received from HTTP clients such as Internet browsers. This length includes the query string which defaults to 4 kilobytes. We do not recommend increasing this limit unless your applications require extremely long query strings.

*Maximum number of URL path segments* limits the number of segments allowed. For example:

http://www.itsoredhat.com/a/b/c/d/e/f/g/h/i/j/k/l/m/n/o/.....etc.

The default value for this setting is 64.

*Maximum number of request headers* helps to protect against buffer overflow probes. By default, the Domino 6 HTTP task allows only 48 headers.

*Maximum size of request headers* limits the actual size or total length of the header in the request. The default setting is 16 kilobytes.

*Maximum size of request content* restricts the amount of data that can be contained in a request such as a form. The default value is 10 megabytes. The “Maximum Post data” setting from Domino R5 is supported in Pre-release 1.

**Note:** Refer to the Domino Administration 6 Help for additional configuration information about these new HTTP security settings.

## 6.4 Troubleshooting

The HTTP process usually operates without incident. However, there are a few issues that are specific to HTTP process troubleshooting described in this section.

### 6.4.1 HTTP does not respond

To check if the HTTP process has hung or simply is overloaded by a lot of client requests, a good basic test you can do is telnet to the process in the right port, by default port 80.

For example, if your Domino server is running on a host named itsoredhat and listening on the default port 80, you have to run the command:

```
# telnet itsoredhat 80
```

The command output is as below:

```
# telnet itsoredhat 80
Trying 9.95.35.56...
Connected to itsoredhat.
Escape character is '^]'.
```

Now you can issue an HTTP command, for example **get**:

```
Trying 9.95.35.56...
Connected to iena.
Escape character is '^]'.
get
```

**Note:** The **get** command should return the HTML header information from your default homepage. This header should include references to Domino and your operating system.

In this case the **get** command receives an answer from the HTTP process; if HTTP was hanging, the **get** command would not receive any responses.

**Note:** This technique can be implemented also for the other Domino Internet processes, like IMAP, LDAP, and POP3, by choosing the appropriate port number (for example, 143 for IMAP) and the appropriate protocol command (for example, **hello** for IMAP).

## 6.4.2 Using the tell command

Domino 6 utilizes a console command that helps in troubleshooting if HTTP hangs. This command is **tell http Show Thread State**.

When entered at the Domino console, this command displays the current status of each active thread, and which URL, if any, the thread is processing.

Following is a sample output for three threads. The first two threads are idle; the third thread (0xf9) is processing the URL

```
GET /reference.nsf/ Refresh?OpenAgent HTTP/1.0
```

```
> tell http show thread state
```

```
06:37:09 PM HTTP Thread State: Thread: [fb] State: [Worker waiting for work]  
Other Info:
```

```
06:37:09 PM HTTP Thread State: Thread: [fc] State: [Worker waiting for work]  
Other Info:
```

```
06:37:09 PM HTTP Thread State: Thread: [f9] State: [Worker processing request]  
Other Info: GET /reference.nsf/Refresh?OpenAgent HTTP/1.0
```

If the HTTP process is in a hung or partially hung state, this command can be used to determine if a particular thread has been processing the same URL for too long. If the thread is still processing the same request or URL for more than a few minutes, then the thread is likely hung. You can check this by repeating the command after a few minutes.

In many cases, if the HTTP task is hung, the Domino administrator can attempt to shut the HTTP server task down, but the task does not always shut down gracefully. In Domino 6, when an administrator issues the command **tell http quit**, if HTTP is waiting for a hung thread to complete during shutdown, HTTP outputs this thread ID and the URL it is working on to the console. For example:

```
> tell http quit
```

```
04/28/2002 06:37:51 PM HTTP Waiting For Thread: Thread: [f9] State: [Worker  
processing request] Other Info: GET /reference.nsf/Refresh?OpenAgent HTTP/1.0
```

This information can be used to determine the hung thread, and which URL the thread is processing. This is similar to the use of the req\*.log files (described in the following section). The thread ID can be correlated against the req\*.log file that pertains to that thread.

### 6.4.3 HTTP thread debugging

Additional diagnostics for the Domino HTTP process are available, and can be enabled when troubleshooting HTTP problems.

A request log file can be created for each worker thread by placing the parameter "debugthreadlogging on" in the httpd.cnf configuration file. When this is enabled, a file is created for each active thread, with information about each request processed appended to the file as requests are made to the server (roughly 10-15 lines per request). These files can be extremely useful to pinpoint causes of HTTP crashes or hangs.

As an alternative to placing "debugthreadlogging on" in the httpd.cnf, administrators can enter the following command at the server console:

```
>tell http debug thread on
```

This dynamically sets the thread logging debug flag, and the server begins to create thread logs immediately. However, this debug flag remains in effect only until the HTTP server is restarted. This method of turning on debug does not place the parameter in the httpd.cnf file.

The created files are named req###.log , where ### is the thread ID for the active thread, and they are written to the Domino data directory. For example, req111.log corresponds to the lwp-id 111 from the nsd.

These req\*.log files do not contain a date/time stamp, so they must be used in conjunction with Domino logging (DOMLOG.NSF or Access logs). However, each line of the logged request displays the number of milliseconds since the HTTP process last started (the bold number in "Start Request" line). This allows you to determine the amount of time that each phase of the request process takes.

**Note:** Use these variables for debugging only. They have a significant impact on Domino server performance when they are enabled.

## 6.5 Domino 6 console tell commands

Lotus Domino 6 has **te11** commands that can be used for the HTTP process. These commands are issued on the server console. Some of the commands are:

- ▶ tell http show users
- ▶ tell http show thread state
- ▶ tell http restart
- ▶ tell http show security

- `tell http show virtual servers`
- `tell http quit`

### ***tell http show users***

This command can only be used if the server is configured to use session-based tracking for the Web. Session tracking is a feature of session-based authentication. To enable it, edit the server document in the Domino Directory. In the Internet Protocols section, select **Domino Web Engine**. By default, the entry for “Session authentication” is disabled. Select **Enabled** to allow the HTTP task to report on authenticated users. This command will show the User Name, IP address and the time of expiration (which is 30 minutes by default). This will only reflect users who are authenticated, and cannot be used to track anonymous users.

### ***tell http show thread state***

This command will list the current state of each active thread (as well as the accept thread and logger thread). If the thread is processing a request, the output of this command will indicate the URL being processed.

### ***tell http restart***

This will cause the HTTP task to shut down and reload. This is the equivalent of **`tell http quit`** followed by **`load http`**. This command is valid for the other Domino processes, too.

### ***tell http show security***

This outputs current status on the use of SSL for the server and each virtual server.

### ***tell http show virtual servers***

This outputs the current configuration for virtual servers.

### ***tell http quit***

This will cause the HTTP task to shut down.

## **6.6 Virtual servers and host**

If you are a corporate intranet administrator who provides services to multiple customers, you can set up *virtual servers* on a single Domino Web server. A single Domino Web server can then host several Web sites. Using virtual servers allows you to maintain separate sites without incurring the expense of additional hardware and software.

You can configure each site in Domino with its own IP address, default home page, customized Web server messages, and HTML, CGI, and icons directories.

The Domino data directory, however, is not individually configured for each virtual server; it is shared by all virtual servers.

The difference between a virtual server and a virtual host is that virtual servers have different IP addresses and different hostnames, while virtual hosts use the same IP address but different hostnames.

**Note:** Refer to system administration documentation for your operating system environment for installing and configuring additional network interface cards and IP addresses. This document only addresses Domino-specific configuration settings.

## 6.6.1 Create virtual server or host

If you want to create a virtual server or host, in the Domino Directory select the Domino server and choose **Actions -> Create Web R5-> Virtual servers** from the menu bar.

Now you will be asked whether you want to create a virtual host or a virtual server.

Choose **Virtual Host**. Creating a virtual server is pretty much the same, except you will be asked for the IP address instead of the hostname.

On the Basics tab, enter the hostname of your added virtual host.

On the Mapping tab, specify the path names mapping to the HTML directory, the Icon directory, the CGI directory, and the home URL, like a Domino Web server configuration. This tab is the same for both server types.

The Security tab lets you make some security settings for your virtual servers. You can decide if Name and password and/or anonymous authentication can be used.

You can also customize the SSL settings to comply with your company's security policies. For more information on SSL, refer to the Domino Administrator 6 Help.

## 6.6.2 Create URL mapping and redirection

There are three different types of URL mappings. Depending on the type you choose, you will get three or four tabs to configure the mapping.

*URL-to-URL* mapping enables you to define an alias name for URL paths. For example, you could map /MyPictures to /images. Figure 6-8 shows URL-to-URL mapping.



*URL-to-Directory* mapping enables you to specify which URL path should be mapped to which real directory on your server. For example, if you have all the images you are using in your Web pages in a directory /web/images, you have to create a directory mapping /web/images to /YourPictureDirectory to be able to access these pictures through the Internet. If you have defined a URL-to-directory mapping, you will also have to specify if your data can only be read or if it should be executable.

*Redirection URL-to-URL*. Using this, you can move pages to a different server without making the old URL invalid.

Figure 6-8 shows the options for the Basics tab.

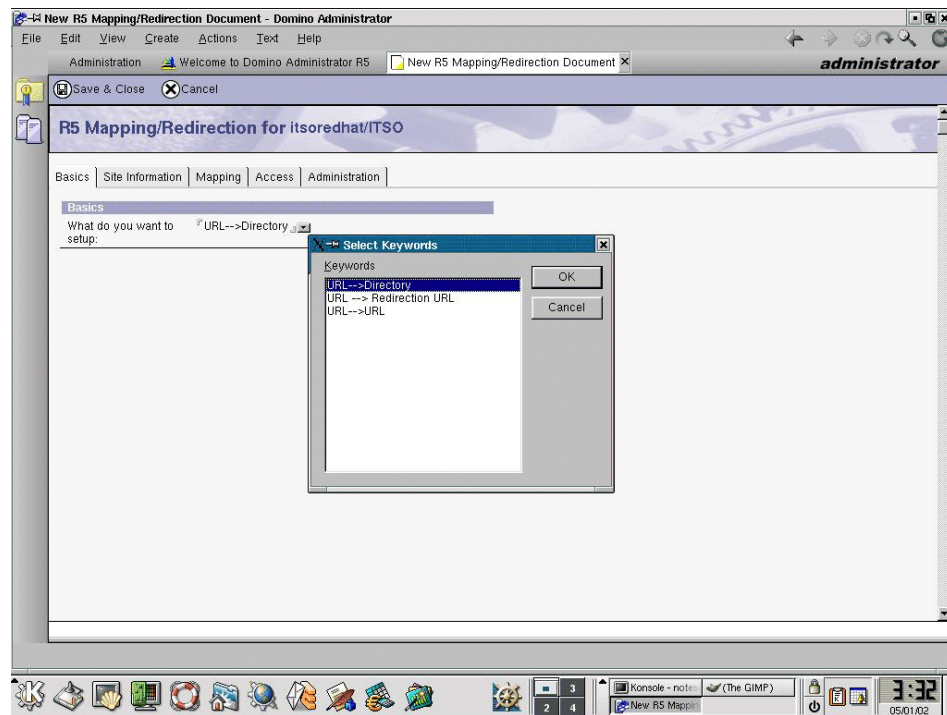


Figure 6-8 URL mapping/redirection document: Basics

Figure 6-9 shows the Site Information tab. For each choice, specify in the Site Information tab which virtual server is affected by this mapping.

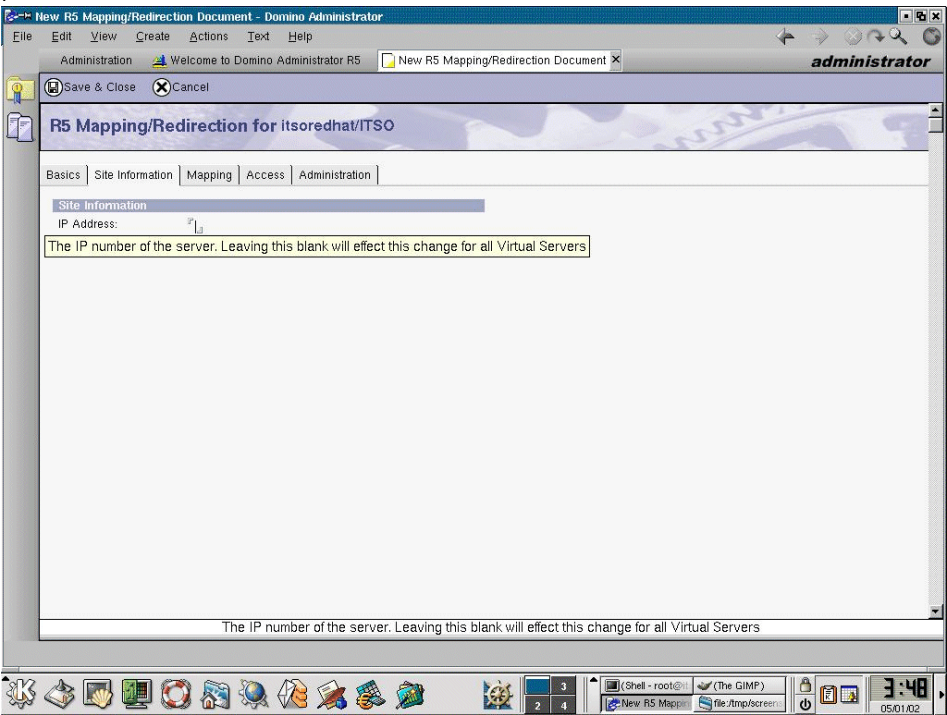


Figure 6-9 URL mapping/redirection: Site Information

Figure 6-10 shows the options available under the Mapping tab. On the Mapping tab, specify the actual mapping.

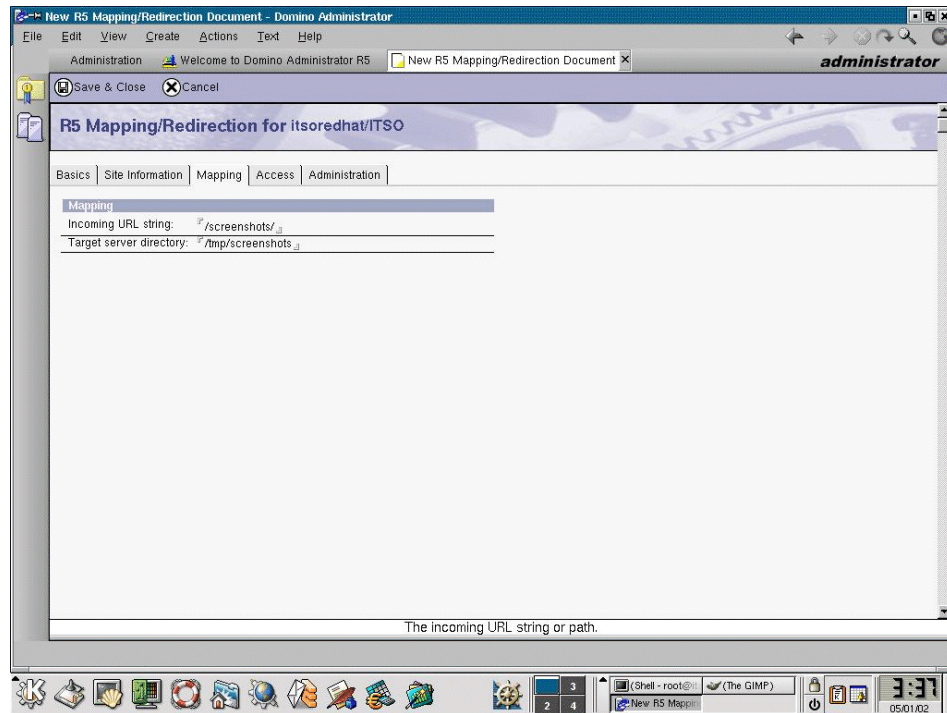


Figure 6-10 URL/Mapping redirection: Mapping

## 6.7 Domino and Java

At the time of this writing Lotus Domino 6 includes a Java Virtual Machine (JVM) based on Sun Microsystem's JDK. The JVM is automatically installed in the Domino program directory.

If you have configured the HTTP server task to support Java servlets, the task will load the JVM when the HTTP task is started. This configuration is available in the Server document under the Internet Protocols tab, Domino Web Engine sub-tab.

## 6.7.1 Java servlets

A servlet is a Java program that runs on a Web server in response to a browser request. Servlets for Domino must conform to the Java Servlet API Specification, an open standard published by Sun Microsystems, Inc.

### Configuring

On a Domino 6 server, Java servlet support is disabled by default. In order to enable Java servlets, edit the server document and go to the Domino Web Engine tab, then find the section labeled “Java Servlets.” Set the appropriate value for the field “Java servlet support.” There are 3 options:

- ▶ None.
- ▶ Domino Servlet Manager (which initializes the Domino JVM and starts the servlet manager).
- ▶ Third party Servlet manager (which initializes the Domino JVM only). In order to use a third party servlet manager, one must install the appropriate software (such as IBM WebSphere) which will in turn place lines in the HTTPD.CNF file to allow the servlet manager to plug in to the Domino HTTP server.

### Running

The basic steps to run a servlet in Domino 6 are as follows:

1. In the “Servlet URL Path” field, enter the URL path you wish to use to indicate that the resource is a servlet (the string `/servlet` is the default).
2. Create a directory under the `/local/notesdata/domino` directory (for instance `domino/servlets`) where you wish to store your servlets.
3. Edit the “Class Path” field to include the location of your specific servlet. You can specify `.jar` and `.zip` files in this field.
4. Copy the class files to the `data/domino/servlets` directory.
5. Issue the server console command **tell http restart** to reload the HTTP server. In your Web browser, enter a URL that contains the servlet name (without the file extension), such as:

```
http://hostname/servlet/HelloWorldServlet
```

**Note:** The addition of any servlets to the servlet directory will require a restart of HTTP before the servlet manager will recognize the new servlet.

## 6.8 Domino log and analysis tools

Domino 6 makes logging even easier for Internet service providers (ISPs), as well as the rest of us. Domino 6 can now create text files that include the IP address or host name of the server that the user requests. This way, you can more easily use the logs to create statistics for virtual servers. To use this feature, you must enable the “Extended log format” for the access log file in the server document.

To create separate statistics for virtual servers, analysis tools still need to sort the entries in the log file according to the different virtual servers’ IP addresses or host names.

### 6.8.1 Domino Web log

To set up logging on your Domino server, you simply enable one of the logging methods in the HTTP section of the server document in the Domino Directory. (Because logging is very server-intensive, it is disabled by default.)

If you enable logging to domlog.nsf, the database is automatically created the next time you start the server. If you enable logging to text files and specify a directory for the files, Domino automatically creates the access log and error log files.

Notice that you can select the format for the access log files (Common or Extended Common) and the time format (LocalTime or GMT). Remember that the Common format records only access information, and the Extended format tracks access, agent, and referred information in the access log file. You can then specify different names for the log files.

Figure 6-11 on page 388 shows the logging fields in the server document.

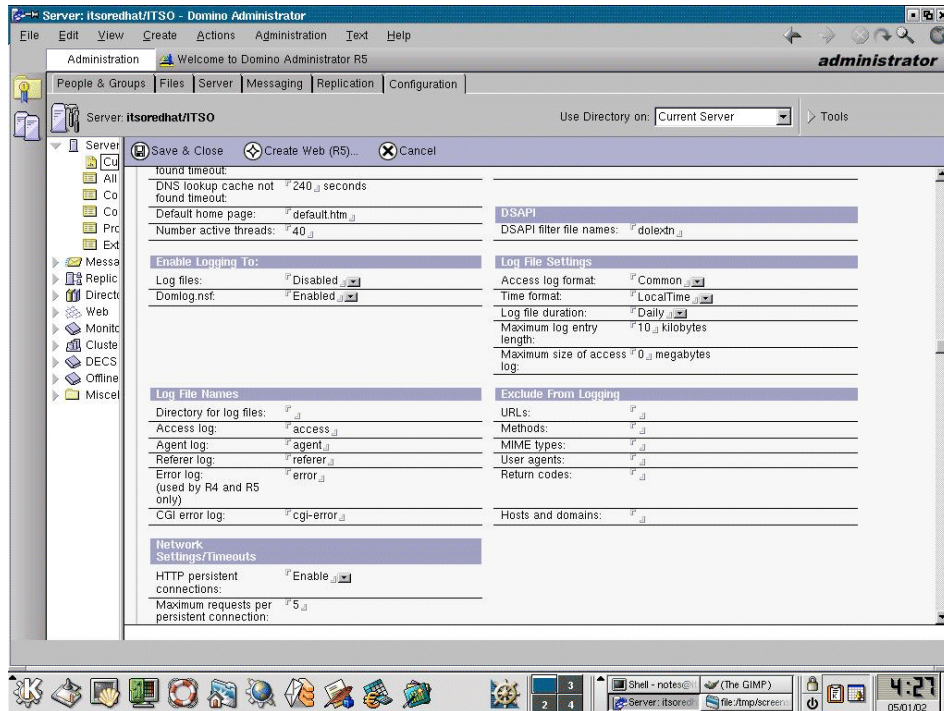


Figure 6-11 Domino Web logs

## Logging fields

With Domino 6, you can specify whether you want Domino to create new log files daily, weekly, monthly, or never. The log file duration applies to all log files on the server. In addition, only one log file is maintained per Web server, including servers set up as virtual servers. The name Domino gives to the log file depends on the duration settings and the file names you specify in the server document.

In the “Exclude from Logging” section, you can prevent logging for specific types of requests. For example, let’s consider that you don’t want to log image requests on your server. So, you enter \*.gif in the URLs field and image/gif, image/jpeg, and image/bmp in the MIME types field.

You can also prevent logging for:

- ▶ Specific HTTP methods
- ▶ User agents
- ▶ Status return codes
- ▶ Hosts and domains

## 6.8.2 Domino Log database analysis

When you enable logging to the Domino Log database, Domino automatically creates the database using the template domlog.ntf. The basic design of the database includes one form for log entries and one view for displaying them, called Requests. The Requests view shows all records in the order that they were created. To analyze the entries in your Domino Log database, you can either use a Notes tool or one of several solutions from Lotus Business Partners. You can customize the database with additional views, create agents to notify you when specific events occur (such as, when a certain number of unsuccessful login attempts occur), or modify the database to generate reports.







## Backup and virus protection

In this chapter we discuss different ways of protecting your Domino server in case of hardware failure, or if your server is attacked by a virus.

You'll get an overview of:

- ▶ Antivirus software for the Linux operating system level and for the Domino server.
- ▶ Operating system backup tools. Linux has its own backup tools that are easy to use and work like those on most other UNIX operating systems.
- ▶ Operating system backup tools from third-party vendors, which are more complex, have a client-server architecture, and are compatible with other platforms.
- ▶ Domino backup tools from different vendors. While Domino server does not have a built-in backup tool, there are some backup tools available from third-party vendors.

## 7.1 Antivirus software

Why do you need antivirus software? Because it protects your data from viruses, scans e-mail for viruses, tells you when you have a virus, and rids your system of viruses.

Antivirus software works on Linux like it does on any other OS. It is uploaded into memory and it scans open files, incoming data, and e-mail for different types of viruses.

There are two types of antivirus software:

- ▶ *Operating system level* antivirus software, which scans the files on the computer for known viruses.
- ▶ *Application level* antivirus software, which is written for a specific application, such as the Domino server.

An operating system level antivirus product can be scheduled to run daily or weekly at certain times (such as at midnight, at night, at the end of the work hours, or the end of the week). We recommend that you schedule the antivirus software to run outside work hours because it is a “heavy” task, demanding a lot of CPU power, memory, and disk access.

### 7.1.1 Operating system level antivirus software

Antivirus software for Linux is a program that scans the files in the computer for known viruses. It may also scan the memory or incoming data. When it finds a virus, it shows a message and acts on the virus (for example, it can erase the virus or put the virus in quarantine).

Following is a list of some of the companies that offer operating system level antivirus software for Linux. For more information, visit their Web pages:

- ▶ Norton AntiVirus, by Symantec <http://www.symantec.com>
- ▶ ServerProtect for Linux, by Trend Micro <http://www.trendmicro.com>
- ▶ eTrust InoculateIT for Linux and eTrust Antivirus, by CA <http://www.ca.com>
- ▶ RAV AntiVirus Desktop, by GeCAD <http://www.rav.ro>
- ▶ Kaspersky Anti-Virus for Linux Servers <http://www.kaspersky.com>

## 7.1.2 Application level antivirus solutions for Domino Server

Antivirus software for the Domino server works at the application level, in this case at the Domino level. It can scan for viruses in Domino databases and in files attached to e-mail messages.

At the time of writing there are a few companies that offer antivirus products for Domino for Linux. Following is a list of some of the companies that offer this type of product. For more information, visit their Web sites:

- ▶ Kaspersky Anti-Virus Business Optimal for Lotus Notes/Domino, by Kaspersky. This was the first product of its kind released.  
<http://www.kaspersky.com>
- ▶ ScanMail for Lotus Notes, from Trend Micro, now includes Linux support. This complements the offerings Trend Micro already has for Windows, AIX, Solaris, OS400, and z/OS. <http://www.trendmicro.com>
- ▶ Norton AntiVirus for Lotus Notes/Domino, by Symantec.  
<http://www.symantec.com>

In the following sections, we describe these solutions in more detail.

### **Kaspersky Anti-Virus Business Optimal for Lotus Notes/Domino**

This product is a centralized anti-virus system for Lotus Notes/Domino for Linux. The program integrates itself into the mail server as a supplemental module and centrally checks for viruses in the incoming and outgoing e-mail traffic in real-time.

Software requirements are as follows:

- ▶ Linux Red Hat 6.0 (or higher)
- ▶ Lotus Domino R5.02 (or higher) for Linux

### **ScanMail for Lotus Notes/Domino**

Trend Micro ScanMail for Lotus Notes Linux is designed to provide a single, comprehensive antivirus strategy for all current Lotus Domino messaging and collaboration environments, with limited performance impact and management cost. In addition, it offers Domino administrators one of the easiest antivirus products on the market to use. ScanMail for Lotus Notes Linux provides an intelligent antivirus and content security strategy to meet the increasing market demand for a protected corporate messaging environment.

Some of the features of ScanMail for Lotus Notes 2.52 Linux are:

► Virus Reduction

Uses multithreaded scan engine architecture to provide scanning with minimal server overhead across a wide range of Lotus Notes server platforms.

Provides the capability to scan e-mail, databases, and replication activity in real time without sacrificing server performance.

Sends a customized alert message to the administrator upon detection of a virus, sender, and receiver. Infected files can be automatically cleaned and sent to recipients, with no disruption in message delivery.

► Database and Replication Scanning

Monitors new or modified documents within Lotus Notes databases, and scans files prior to closing.

Administrators can specify the databases to be scanned from either the Lotus Notes console or the ScanMail for Lotus Notes interface. All modified data can be scanned during replication.

Cleans existing database infections using on-demand and scheduled scanning. Separate settings are available for scanning options and notifications.

► High-performance Scanning

Provides diskless scanning to maximize scanning efficiency and minimize overhead impact on Lotus Notes servers.

Cleans existing database infections using on-demand scanning.

Provides broad platform support and scalability to meet the virus protection needs of growing enterprises.

Using Trend Micro SmartScan™ technology, administrators can define trusted servers within their Notes environment, allowing servers to skip redundant scanning and improve overall scanning efficiency.

Incremental scanning allows administrators to scan only those documents that have been modified since the previous scan.

Assists secure message delivery with policy-based e-mail filtering.

► Flexible, Native Configuration and Management

Provides access to the ScanMail intuitive Lotus Notes interface from any Lotus Notes workstation (including full integration in the Lotus Domino administration Client) or Web browser.

- ▶ Support of Lotus Domino Enhancements  
ScanMail for Lotus Notes supports the Lotus Domino cluster and partition technology on all platforms, including the supported Linux distributions.  
ScanMail for Lotus Notes supports the Lotus Domino-based unified messaging solutions, such as Lotus Quickplace and Lotus Sametime (if available from Lotus on the required OS).

### ***Installing Trend Micro ScanMail for Lotus Notes/Domino***

In this section we describe how to install Trend Micro ScanMail for Lotus Domino.

The system requirements are:

- ▶ Operating systems:
  - RedHat versions 6.2 or higher
  - SuSE versions 6.4 or higher
- ▶ Lotus Domino:
  - Domino Server versions 5.0.3 or higher
- ▶ 40 MB available free disk space for program files, and 100 MB free disk space for swap files

**Note:** We recommend that you consult the readme file for the latest information before you install. This file is included in the package with the program.

### ***Pre-installation tasks***

No special setup is required for the Domino installation or OS before you install Trend Micro ScanMail for Lotus Domino. However, during the installation you may be asked for information about your existing installation, so, for your convenience, ensure you have this available before you start.

You should know the following:

- ▶ What UNIX account you use to run the Domino server
- ▶ What data directory you want to install on (or data directories in the case of a partitioned server)
- ▶ If you are not installing an evaluation license, you should have the ScanMail serial number available.
- ▶ Decide where you want your temporary files to reside

### ***Installation***

1. Stop the Domino server before installing ScanMail.

2. You must be logged in to the Linux server as root to install ScanMail. (For partitioned servers, install a copy of ScanMail on each partition.)
3. Depending on whether you get the program package from a CD or download it from the Web, expand the archive to an area on your machine.

You should now see the vlotus.tz file, the install script sminst, the readme file readme.txt. and the License Agreement file.

4. Next, change to that directory and enter the following:

```
./sminst install
```

If the file sminst is not executable, change it to executable; for example, `chmod +rx sminst`.

You are now requested to read and accept the License Agreement; see Figure 7-1 on page 397.

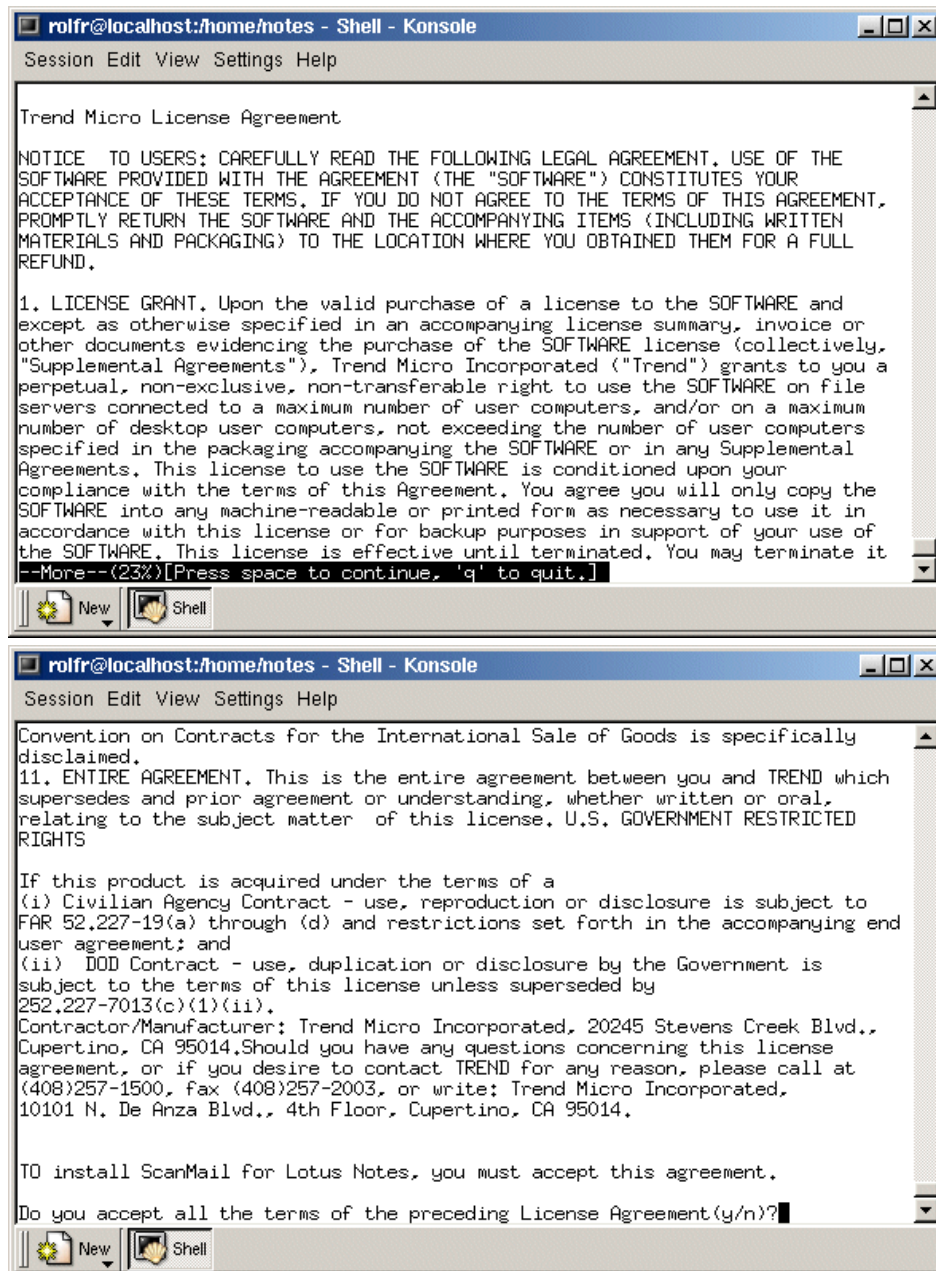


Figure 7-1 Accept License Agreement

Accept the License Agreement. Next, you are prompted for the UNIX account under which you are running the Domino servers. You may also be prompted for

the data directory in case the install script can't fully qualify the notes.ini file; see Figure 7-2.

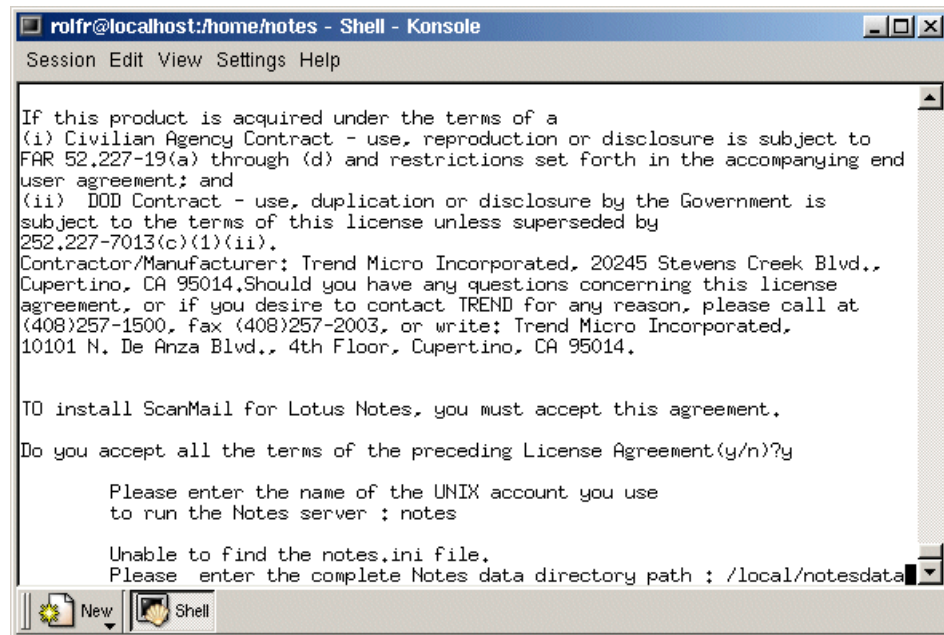


Figure 7-2 Path to Domino Data Directory

If multiple Notes partitions are detected, you are prompted to identify which partition you want ScanMail installed on.

**Note:** Install a separate instance of ScanMail for each partition you want to protect, but do *not* use the same /temp directory for all instances.

Next, you will be prompted for a serial number. If you are installing an evaluation of ScanMail, you may leave this blank and you will install a 30-day trial version.

If you have a full license, you should enter the ScanMail serial number; see Figure 7-3 on page 399. The serial number can be found in the package provided to you, or enclosed in the License Agreement. You may also have received the serial number by fax or email.



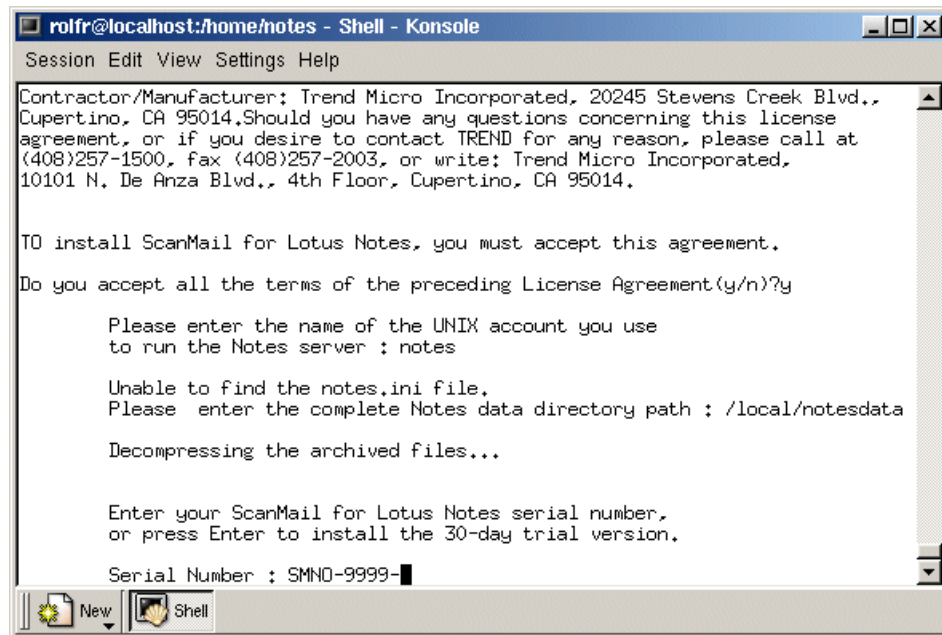


Figure 7-3 Enter Serial Number

Next, you are prompted for the ScanMail temporary directories.

Press Enter to accept the default, or enter the path that you want ScanMail to use.

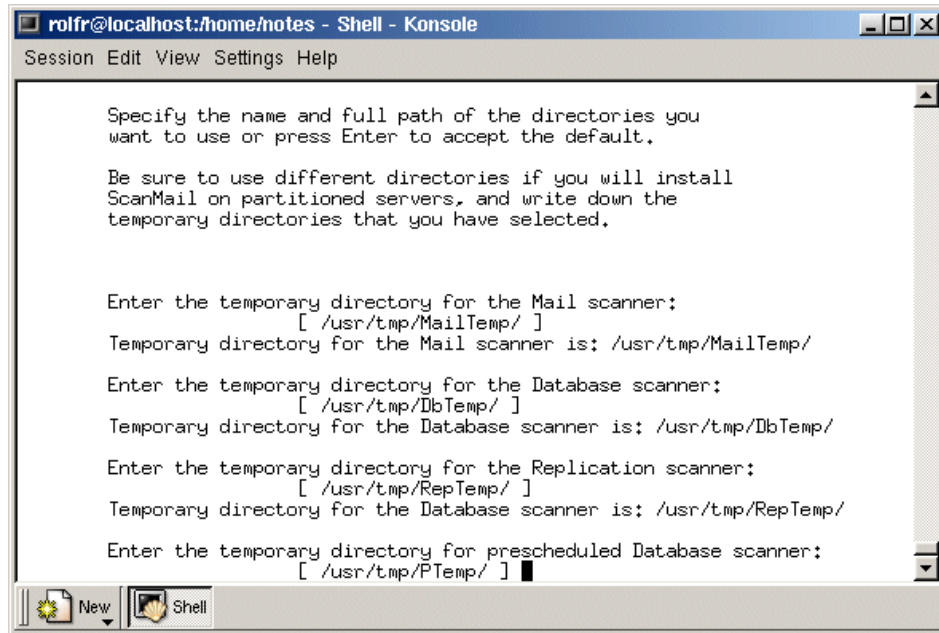
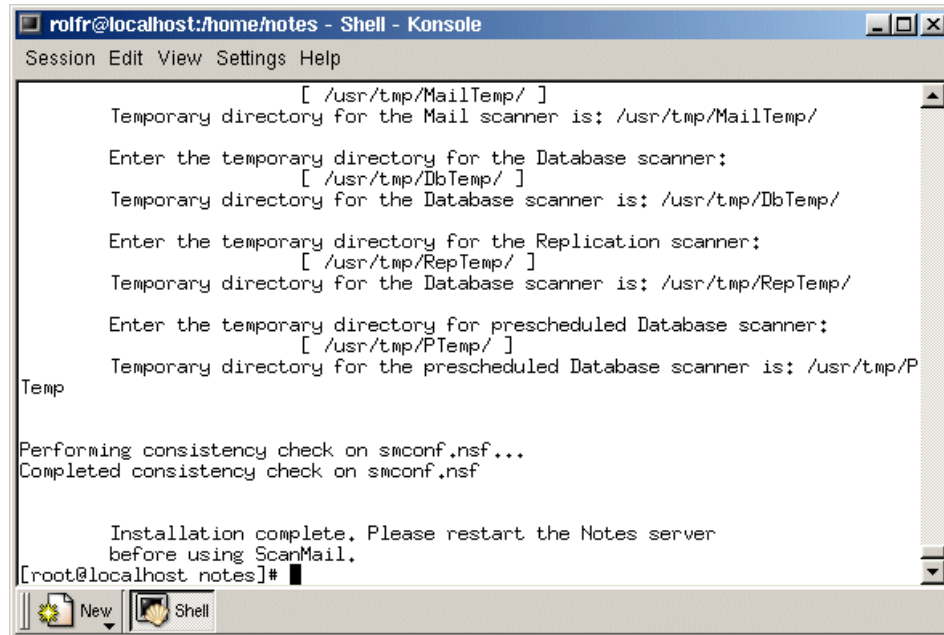


Figure 7-4 Location of temporary files

**Note:** When installing ScanMail on multiple partitions, use a different temp directory for each installation of ScanMail; do *not* use the same directory for all partitions.



```
rolfr@localhost:/home/notes - Shell - Konsole
Session Edit View Settings Help

[ /usr/tmp/MailTemp/ ]
Temporary directory for the Mail scanner is: /usr/tmp/MailTemp/

Enter the temporary directory for the Database scanner:
[ /usr/tmp/DbTemp/ ]
Temporary directory for the Database scanner is: /usr/tmp/DbTemp/

Enter the temporary directory for the Replication scanner:
[ /usr/tmp/RepTemp/ ]
Temporary directory for the Database scanner is: /usr/tmp/RepTemp/

Enter the temporary directory for the prescheduled Database scanner:
[ /usr/tmp/PTemp/ ]
Temporary directory for the prescheduled Database scanner is: /usr/tmp/P
Temp

Performing consistency check on smconf.nsf...
Completed consistency check on smconf.nsf

Installation complete. Please restart the Notes server
before using ScanMail.
[root@localhost notes]#
```

Figure 7-5 Installation complete screen

After the installation finishes, you should start the Domino server before configuring ScanMail to your preferences.

**Note:** By default, all the real-time ScanMail scanning functions are enabled when the Domino server is started to ensure your protection. Individual services can be configured from their individual configuration documents.

### Post-installation tasks

After installing ScanMail, we recommend that you add the ScanMail program icons to your workspace for convenience, sign the ScanMail databases using the administrator ID (an ID allowed to execute unrestricted agents), and set up access control restrictions.

For more information, see the Getting Started Guide, available at:  
<http://www.trendmicro.com/download/documentation/emailgroup/smln.htm>

### **Configuration of Trend Micro ScanMail for Lotus Notes/Domino**

After starting the server, ScanMail begins operating and you are not required to perform any actions. However, we recommend that you go through the

configuration and familiarize yourself with the default settings, and change them as needed to match your security requirements.

ScanMail provides several ways to do administration. In addition to supporting the Notes interface for administration, you can also opt to configure and control the ScanMail tasks from a Web browser or the Admin Console. To use the Web interface, just access:

`http://<your_server>/smconf.nsf`

If you want to make Web access safer, see the discussion about setting Database Flags on page 410. To enable the Admin Console, you have to open the database `smadmR5.nsf` and run the agent provided.

ScanMail also supports replication of the configuration database, for easy control of a large number of servers or a distributed environment.

When you open up the ScanMail configuration database, `smconf.nsf`, you will see the following screen.

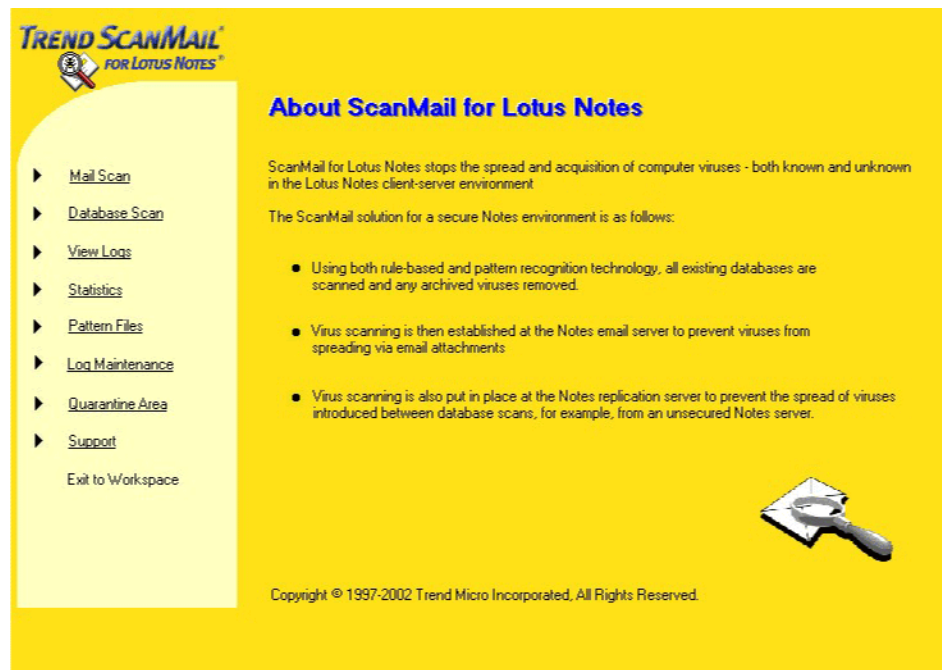


Figure 7-6 Main configuration screen

We recommend that you review the settings under MailScan and Database Scan - Real-time Scan, since these are automatically active after installation; see Figure 7-8 on page 404.

You can then review the other features for Email Filter Rules and set up a policy for Scheduled or Manual Database Scan.

If you have purchased ScanMail, you should register and set up an update schedule under Pattern Files, so automatic updates will be enabled. (The automatic update is disabled for the 30-day evaluation.)

For more help, you can access the help database (smhelp.nsf) directly (Figure 7-7), or select it under Support in the main configuration screen.

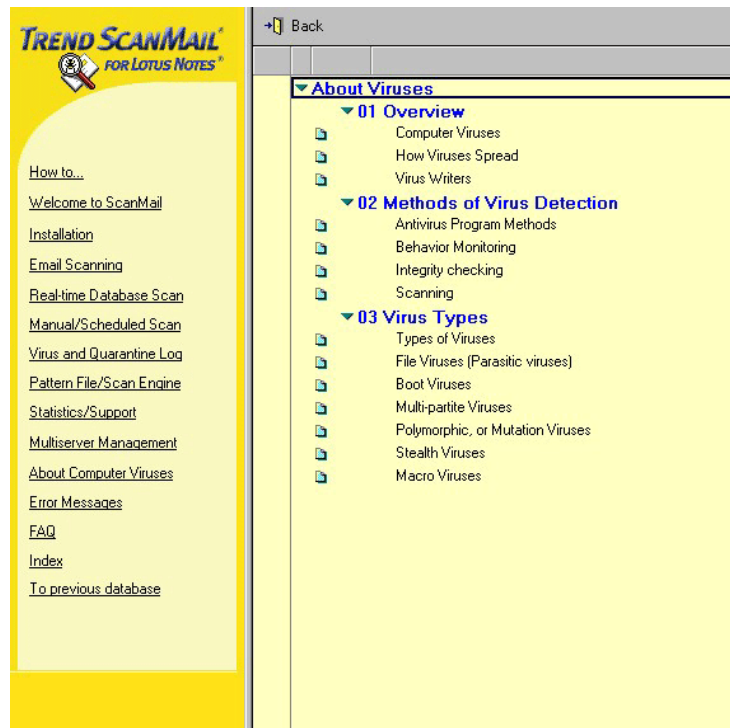


Figure 7-7 Help screen

In Mail Scan configuration, you can start by selecting what to scan. We recommend scanning all files, including compressed files and embedded objects.

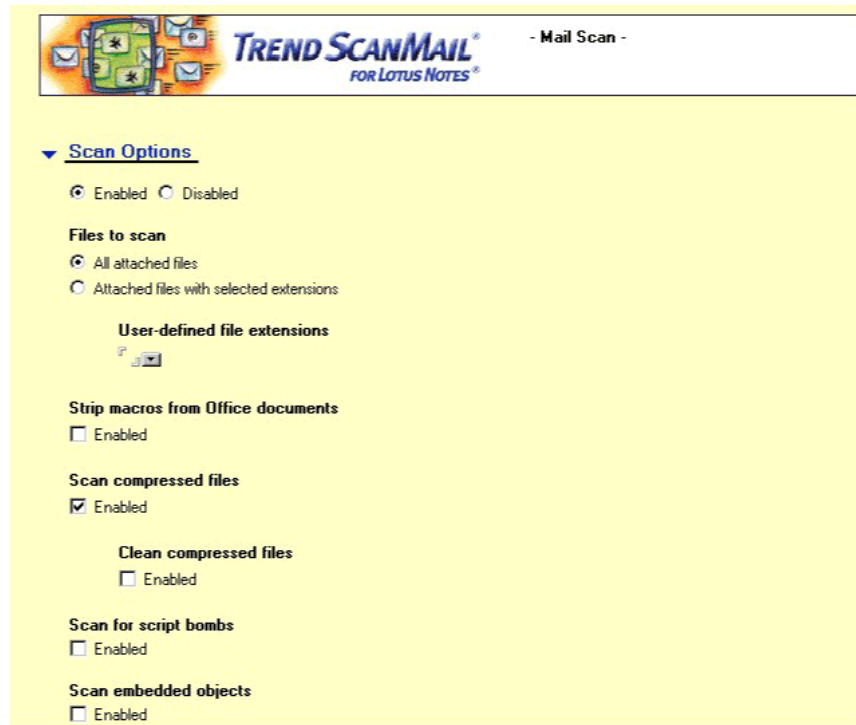


Figure 7-8 Scan options

Proceed to the selection of actions to take upon detecting a virus, and select what matches your security policy (Figure 7-9 on page 405).

▼ **Action On Viruses**

**Action on cleanable files**

- ☐ Pass: Do nothing to infected files
- ☐ Quarantine: Move infected files into quarantine database
- ☐ Delete: Delete infected files
- ☐ Block: Block delivery of mail with infected files
- ☒ Auto Clean: Automatically clean virus infected files

**Action on uncleanable files**

- ☐ Pass
- ☒ Quarantine
- ☐ Delete
- ☐ Block

---

▶ **Virus Notification**

▶ **Virus Logging Options**

▶ **Email Stamps**

▶ **Email Filter Rules**

▶ **Attachment Blocking**

▶ **Temporary Directory**

Figure 7-9 More options

After this, you should review what levels of notifications are desirable and change the texts for these to fit your policies and needs; see Figure 7-10 on page 406.

▼ **Virus Notification**

**Notification message return address**  
 ⓘ Admin Antivirus/TrendMicro/DE ⓘ

☐ Enable rich text notification Update rich text notification

☒ **Warning to administrators:**

☐ Disable notification when viruses are cleaned

**Administrator(s)** ⓘ Admin Antivirus/TrendMicro/DE ⓘ

**Text:** ⓘ Changed Message to Admin - ScanMail has detected a virus during a real-time scan of the email traffic. ⓘ

☒ **Warning to sender:**

**External** ⓘ ScanMail has detected a virus during a real-time scan of the email traffic. ⓘ  
**Internal** ⓘ ScanMail has detected a virus during a real-time scan of the email traffic. ⓘ

☒ **Warning to recipient(s):**

**External** ⓘ ScanMail has detected a virus during a real-time scan of the email traffic. ⓘ  
**Internal** ⓘ ScanMail has detected a virus during a real-time scan of the email traffic. ⓘ

☐ **Send message to sender that entire email message was blocked**

**External** ⓘ ScanMail has blocked your infected email due to mail restrictions. ⓘ  
**Internal** ⓘ ScanMail has blocked your infected email due to mail restrictions. ⓘ

***Add warning to the original email if a virus is detected!!***

Figure 7-10 Notification screen

Similar settings should be done for the Real-time database scan and for the Scheduled and Manual database scan.

A number of other options will be presented. One of the most widely used is the ability to block attachments or e-mail based on the real file type of an attachment, rather than on the filename/extension; see Figure 7-11 on page 407.



▼ **Attachment Blocking**

**Attachment blocking by content**

☐ All

**or attachments of type:**


☐ Office ☐ Archives

☐ Executables ☐ Embedded Objects



☐ Audio / Video ☐ Other

☐ Pictures



**Attachment blocking by extension**

☐ 



☐ **Warning to administrator(s):**

**Text**  ScanMail has removed an attachment during a real-time scan of the email traffic. 

☐ **Warning to sender:**



**Text**  ScanMail has removed an attachment during a real-time scan of the email traffic. 

☐ **Warning to recipient(s):**

**Text**  ScanMail has removed an attachment during a real-time scan of the email traffic. 

**Message in subject line:**

☐ Enabled

**Text**  (ScanMail has removed a file) 

**Attachment blocking exclusions**

☐ Enabled

**Recipient exception list:**



☐ 

Figure 7-11 Attachment Blocking

If you configure Attachment Blocking within the scan configuration page, you can block individual attachments of the mail. In Mail Filter Rules, you can create a policy to block an entire e-mail based on attachments or other properties; see Figure 7-12 on page 408.



**TREND SCANMAIL®**  
 FOR LOTUS NOTES®

- Mail Filter Rules -

**Priority number:**

**Domain filter:**

**Sender exception list:**

**Rule set:**

- ☐ Block always
- ☐ Set to low priority
- ☐ Send at a specified time
- ☐ Block if size exceeds limit
- ☐ Block if attachment matches
- ☐ Block encrypted inbound mail
- ☐ Block encrypted outbound mail

**Activate filter rule:** ☐ Enabled

**If checkmark not set, this filter rule is not active!!**

**Send a notification message to the sender:**

☐ Enabled

**Subject:**

**Please insert a self explanatory description of the filter rule:**

**Body:**

Figure 7-12 Filter rules

You should also familiarize yourself with the Log and Quarantine section. Here you can easily select views to find the information you are seeking. Virus Log Statistics provide you with reports of virus activity.

ScanMail lets you set up replication of the virus log and have a central view of your entire organization. This is especially important if you have a large number of servers or a central call/support center.

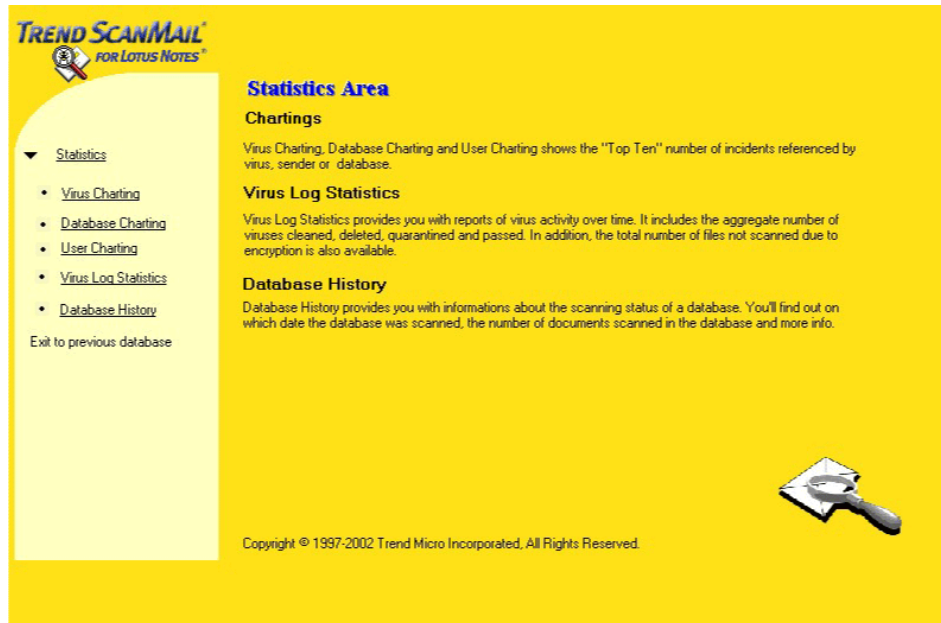


Figure 7-13 Statistics screen

You can develop powerful Top Ten pie charts to show the most frequent viruses, databases affected, or users in detected incidents; see Figure 7-14 on page 410. This is useful for high level views for inclusion in reports.

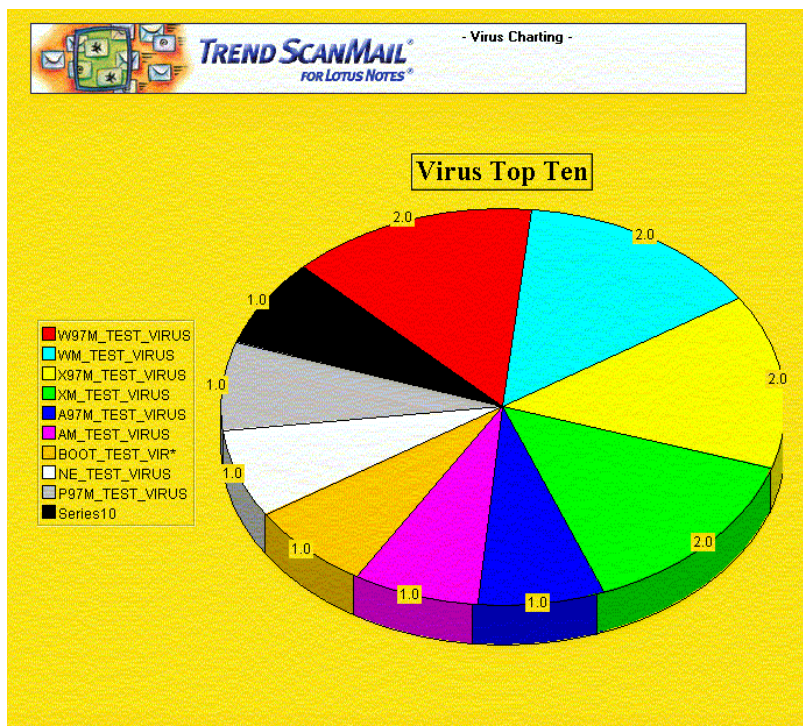


Figure 7-14 Virus charting

Under Database Flag configuration, shown in Figure 7-15 on page 411, you can select how you want the ScanMail databases to be viewable for users. This is to assist you in tailoring the environment, in addition to setting the ACLs. In the same screen, you can also determine if you require SSL to be used for Web-based administration.

All settings can be applied to one or more servers at the same time, using the Name and Address Book to select the servers.

- Database Flags -

Server: Result

TM\_AVTEST50/TM\_AV1/DE

Database	Flags	Action		
<b>Program Config Database</b>	Show in 'Open Database' Dialog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
<b>smconf.nsf</b>	List in Database Catalog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
	Web access: Require SSL connection	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
<b>Virus Log Database</b>	Show in 'Open Database' Dialog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
<b>smvlog.nsf</b>	List in Database Catalog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
	Web access: Require SSL connection	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
<b>Message Database</b>	Show in 'Open Database' Dialog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
<b>smmsg.nsf</b>	List in Database Catalog	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change
	Web access: Require SSL connection	<input type="radio"/> Enable	<input type="radio"/> Disable	<input checked="" type="radio"/> Do not change

Figure 7-15 Database flags

## Norton AntiVirus for Lotus Notes/Domino

In addition to OS-level antivirus software, Symantec has a specific antivirus product for Domino server. At the time of writing, the current version of Norton AntiVirus for Lotus/Notes Domino (NAV) is 2.5.

Among the features of Norton AntiVirus are:

- ▶ It eliminates viruses automatically.
- ▶ It quarantines infected documents and sends an e-mail to the administrator for review and actions.
- ▶ It runs as an add-in Domino task and its name is NNTASK. You can find it in the ServerTasks= line of the notes.ini file.
- ▶ LiveUpdate software lets administrators automatically download the latest virus definitions and deploy them throughout the Domino environment from one location.

## ***Installing Norton AntiVirus for Lotus Notes/Domino***

In this section we describe how to install Norton AntiVirus for Lotus Notes/Domino.

**Attention:** We recommend that you read the Readme file on the Norton AntiVirus CD prior to installation.

### ***System requirements***

Following are the system requirements necessary to install Norton AntiVirus for Lotus Notes/Domino.

- ▶ Operating systems:
  - RedHat versions 6.2 or higher
  - SuSE 7.3 or higher
- ▶ Lotus Notes: Domino Server R5 versions 5.0.9 or higher
- ▶ Available disk space of 200 MB on the partition on which Norton AntiVirus for Lotus Notes/Domino is installed

### ***Pre-installation tasks***

First, you have to create a group, which must be called `avdefs`, and your OS Notes user must be a member of this group so it can read and write the NAV files. Do this with the following steps:

1. Log in as root.
2. Add a group called `avdefs` with:  
`groupadd avdefs`
3. Add a user to the group with:  
`usermod -G avdefs < notes user>`

### ***Installation***

Shut down the Domino server.

For a SuSE distribution, log in as root and run the commands shown in Example 7-1.

#### ***Example 7-1***

---

```
# mount /dev/cdrom
# cd /media/cdrom
# ./install
```

---

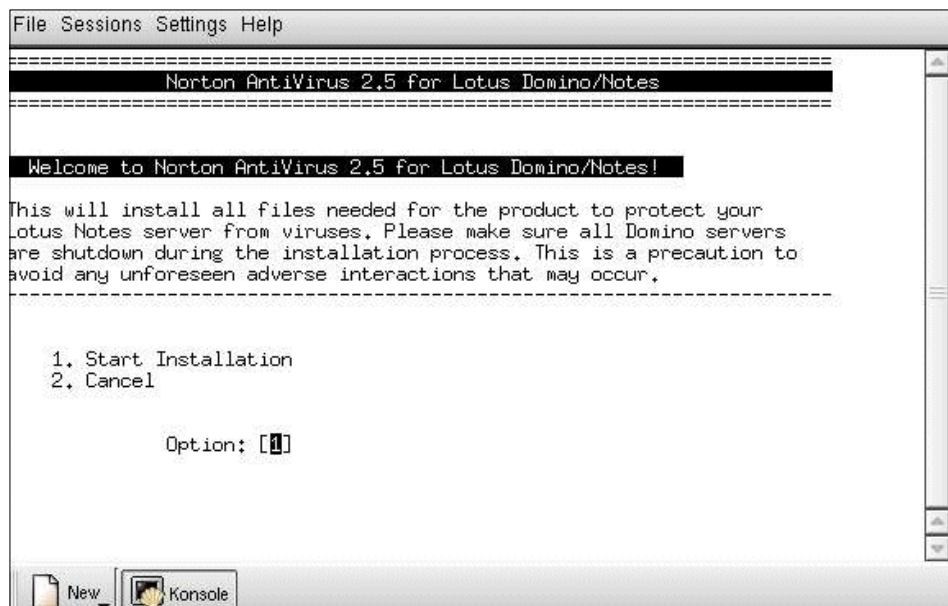
For a RedHat distribution, log in as root and run the commands shown in Example 7-2.

*Example 7-2*

```
# mount /dev/cdrom
# cd /mnt/cdrom
# ./install
```

This starts the installation, and you will see the Welcome screen shown in Figure 7-16.

The installation of NAV on both the SuSE and RedHat distributions is the same. Screen captures in this section were made with RedHat, but they should look almost the same in SuSE. Follow these steps to finish the installation.



*Figure 7-16 Norton AntiVirus welcome screen*

1. Enter 1 and press Enter to start the installation.
2. You will be presented with the License Agreement screen; see Figure 7-17 on page 414.



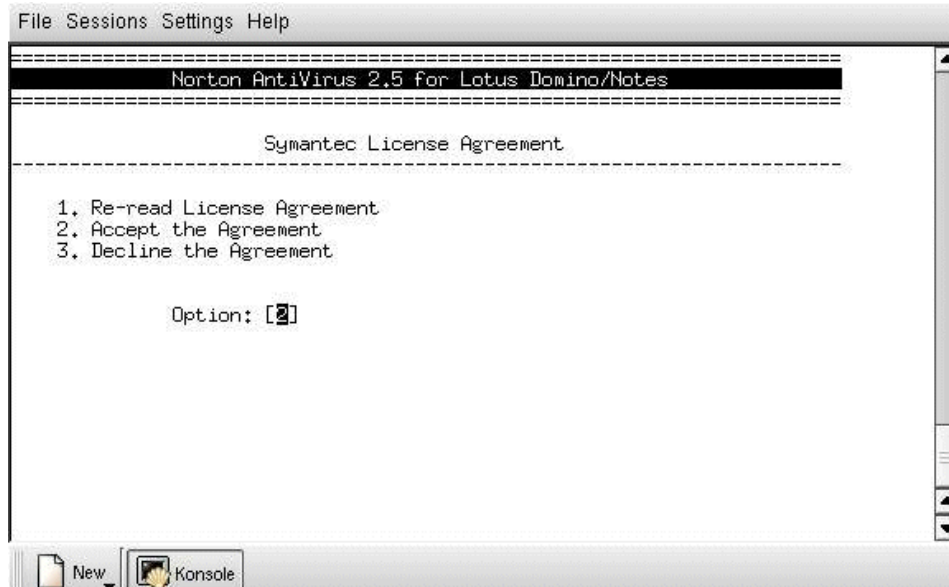


Figure 7-17 License Agreement

3. After you have read the License Agreement, accept the agreement by selecting option 2.

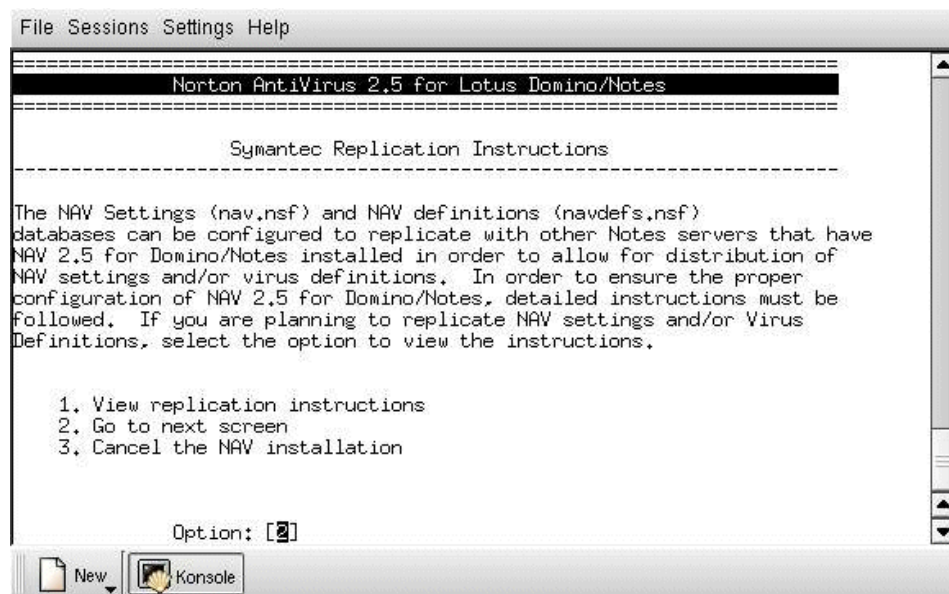


Figure 7-18 Replication Instructions



4. Review the Replication Instructions, then go to the next screen by selecting option 2.

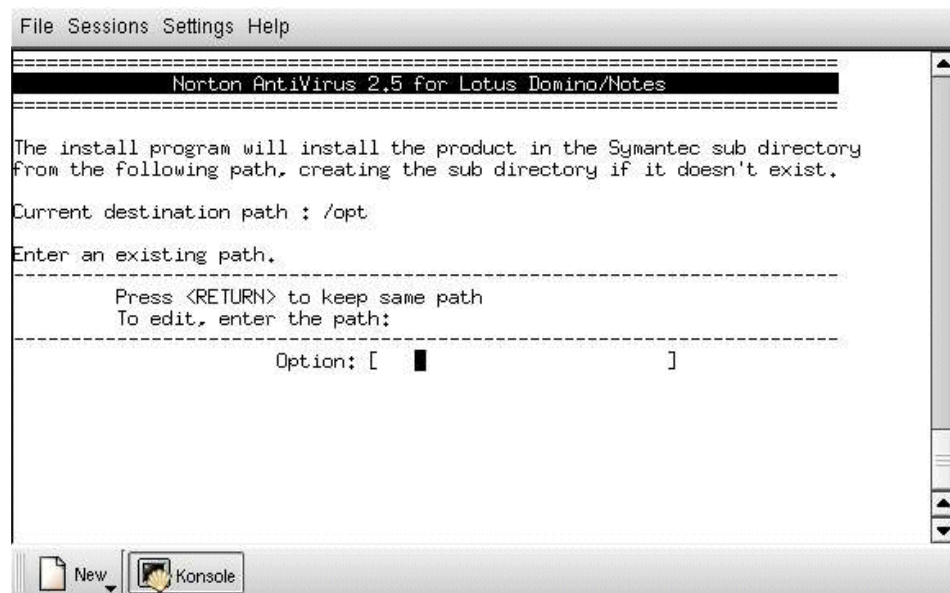


Figure 7-19 Destination path

5. The installation program suggests /opt for the path of the installation. If you want to modify this, key in the new path and press Enter. Otherwise, accept the default by pressing Enter; see Figure 7-19.
6. If you have more than one Domino server running on the same server machine, you need to add the <notesdata directory path > for each Domino server so the NAV can scan all data directories of your Domino servers.  
If you have only one Domino server, make sure the path is correct, then type C and press Enter to continue; see Figure 7-20 on page 416.



Figure 7-20 Listing of Domino partitions

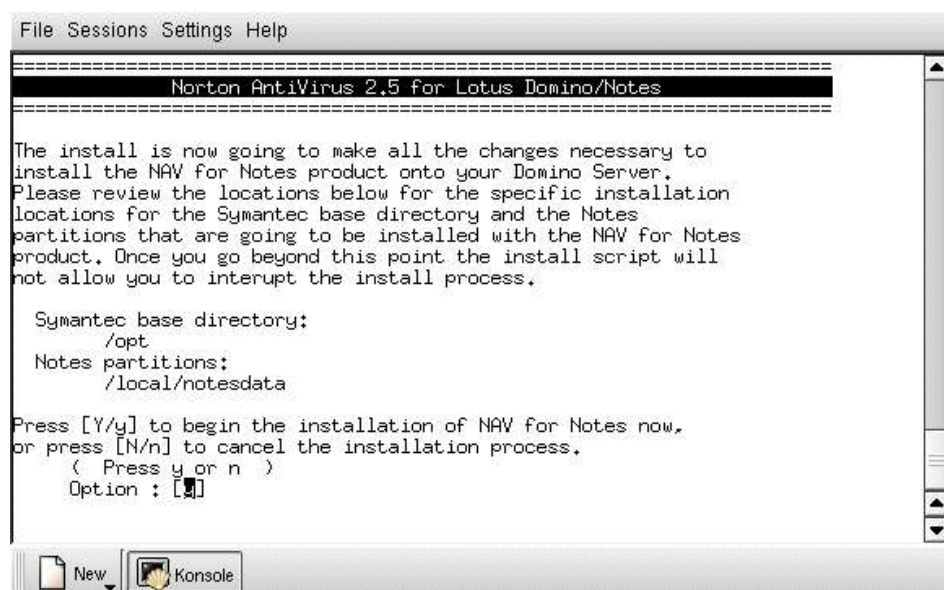


Figure 7-21 Confirming the directories and starting the install

7. To confirm the directory locations and start the installation process, type y and press Enter; see Figure 7-21.

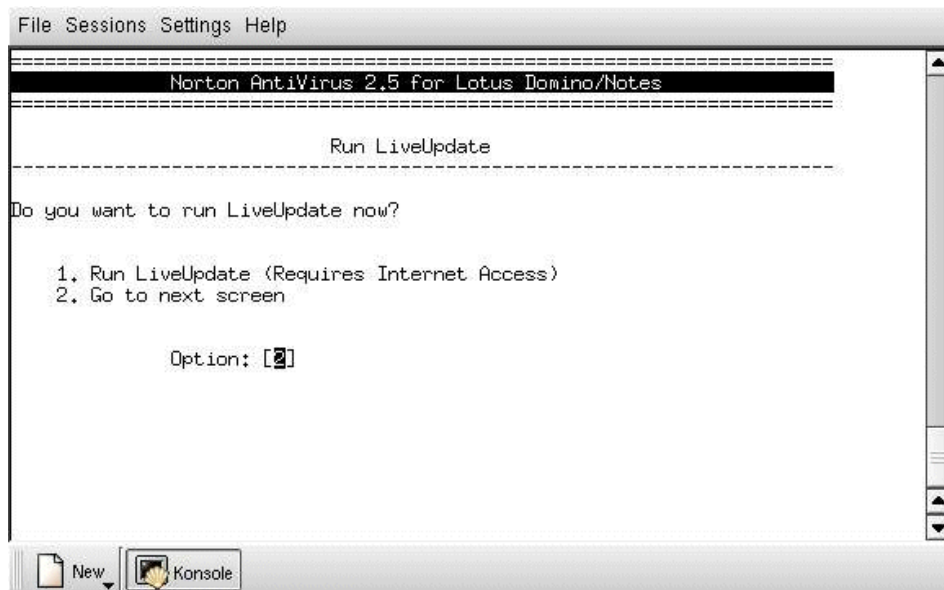


Figure 7-22 LiveUpdate

8. If you want to update the virus definitions now select 1; otherwise select 2. Press Enter to go to the next screen.

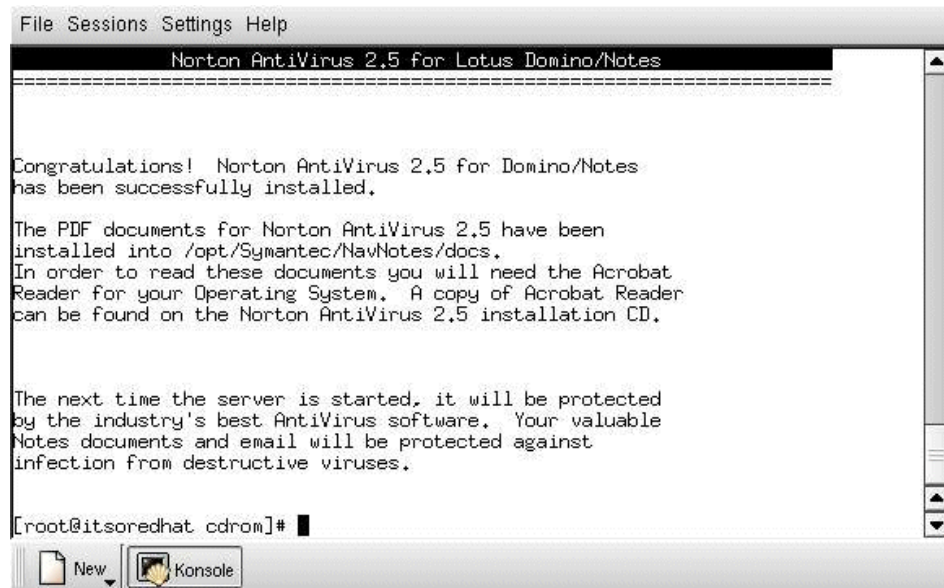


Figure 7-23 Completed installation

9. When the installation is completed successfully you will be presented with a screen as shown in Figure 7-23.

**Attention:** For further information, and to learn about advanced features and customizing, refer to the Norton AntiVirus documentation provided on the Norton AntiVirus for Linux CD.

After you install the NAV, log out and then log in as Notes user, and start the Domino server.

## Configuring Norton AntiVirus

The NAV task starts automatically when the Domino server starts. You can shut down the task directly from the Domino server console by entering:

```
tell nntask quit
```

You can start the task by entering:

```
load nntask
```

To configure settings for NAV you need to open the NAV Settings database (nav.nsf) which is located in the NAV subdirectory of your Notes subdirectory (in our case, /local/notesdata/nav/nav.nsf).

Follow these steps:

1. Log in to Linux as Notes user and start the Domino server (unless you have already done so).
2. On your Windows or Linux workstation, connect to the Domino server with Lotus Notes client and open the NAV setting database.

The NAV settings are in this database, as shown in Figure 7-24.

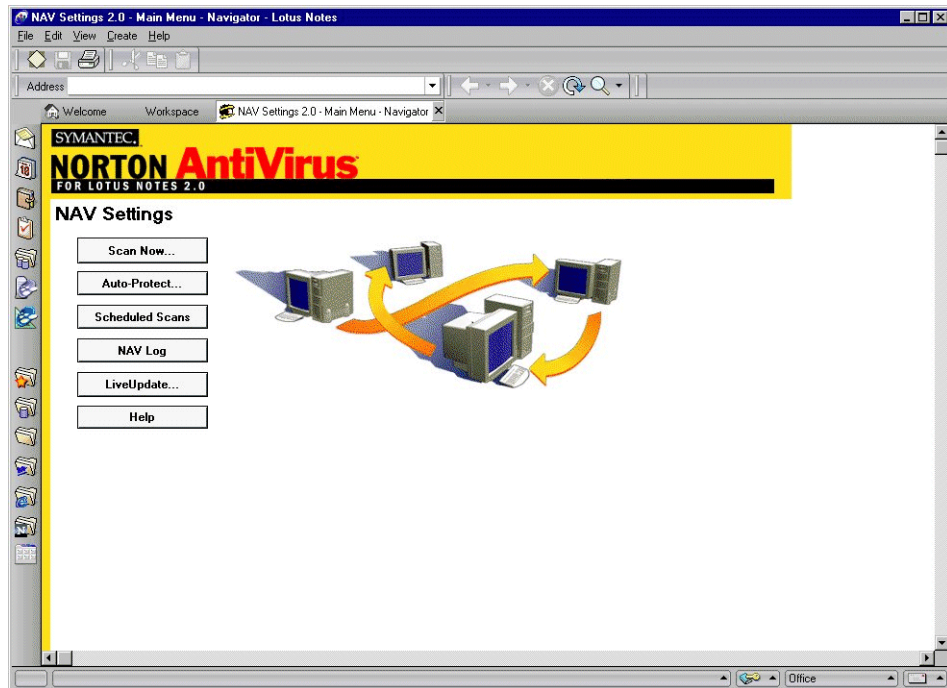


Figure 7-24 The NAV settings

To maintain antivirus security in your Lotus Notes environment, restrict access to the NAV settings (nav.nsf), the NAV log (navlog.nsf), and the NAV definitions (navdefs.nsf) databases to antivirus administrators or Domino administrators only.

**Attention:** Be sure to always keep Manager access for the server group LocalDomainServer so that NAV works properly.

### **LiveUpdate**

To update the virus definitions, open the NAV Setting database and click **LiveUpdate**. This opens the settings document. In this document you can choose to update the virus definitions manually by clicking **Run LiveUpdate**

**Now** or you can schedule it. As shown in Figure 7-25, we selected Live Update to run automatically and scheduled it to run at 3 AM daily.

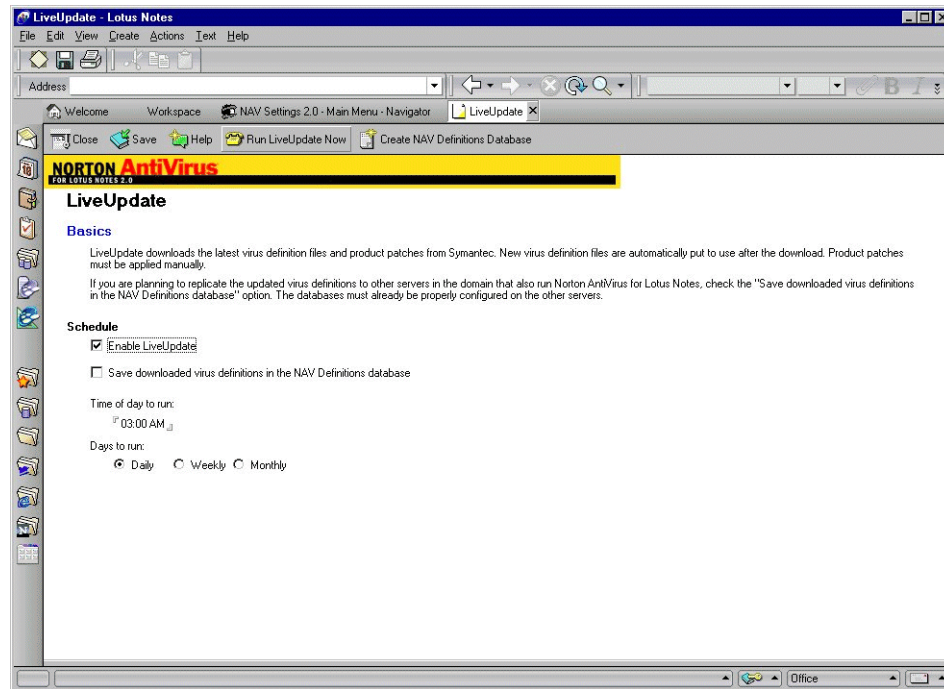


Figure 7-25 LiveUpdate Document

## Uninstalling Norton AntiVirus

To uninstall Norton AntiVirus for Lotus Notes, follow these steps:

1. Shut down the Lotus Notes server.
2. Log out the Notes user.
3. Log in as root.
4. At the command prompt, type the following to navigate to the folder where uninstall is started:

```
cd /opt/Symantec/NavNotes/uninstall
```

5. Type:

```
./uninstall
```

This starts the uninstallation. Use the following steps to complete the uninstallation.

1. To start the uninstallation, type 1 and press Enter; see Figure 7-26 on page 421.

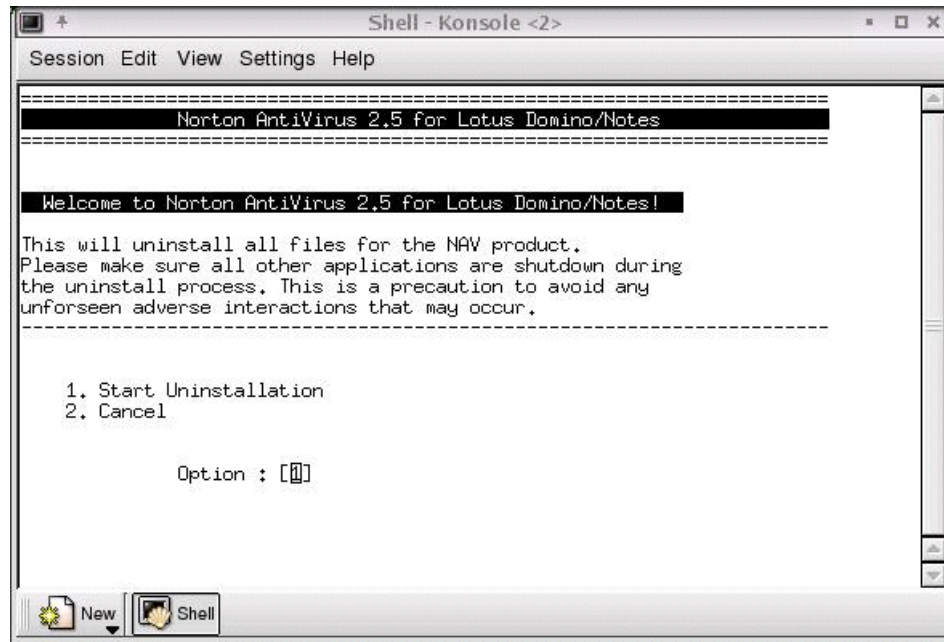


Figure 7-26 Uninstalling Norton AntiVirus

2. If you want to keep the NAVlog database (navlog.nsf) type y and press Enter; see Figure 7-27 on page 422.

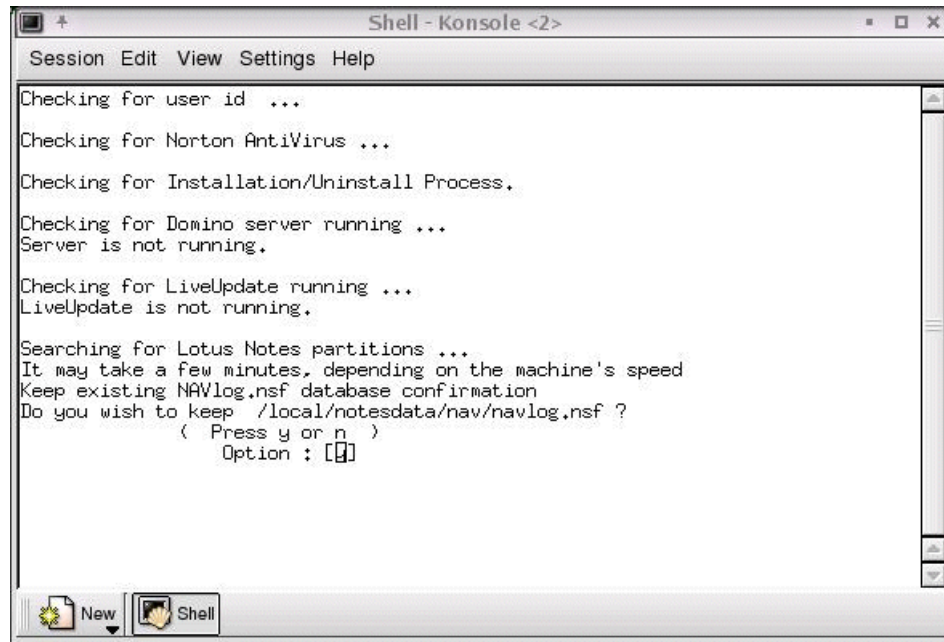


Figure 7-27 Checking if the LiveUpdate is running

3. If you want to keep the NAV settings database (nav.nsf) type y and press Enter; see Figure 7-28 on page 423.



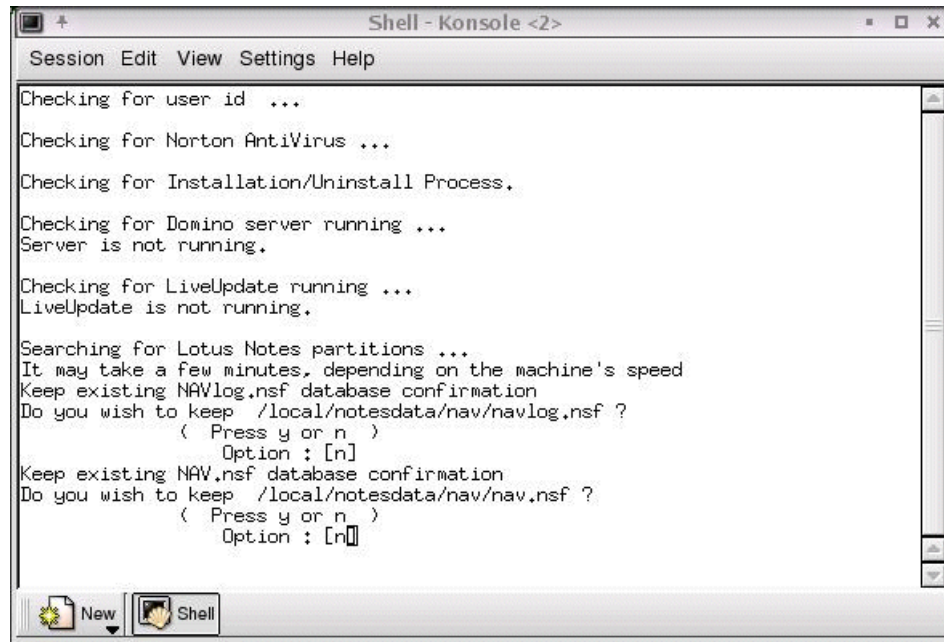


Figure 7-28 Uninstallation

4. When the uninstall has completed successfully, you will be presented with the screen shown in Figure 7-29 on page 424.

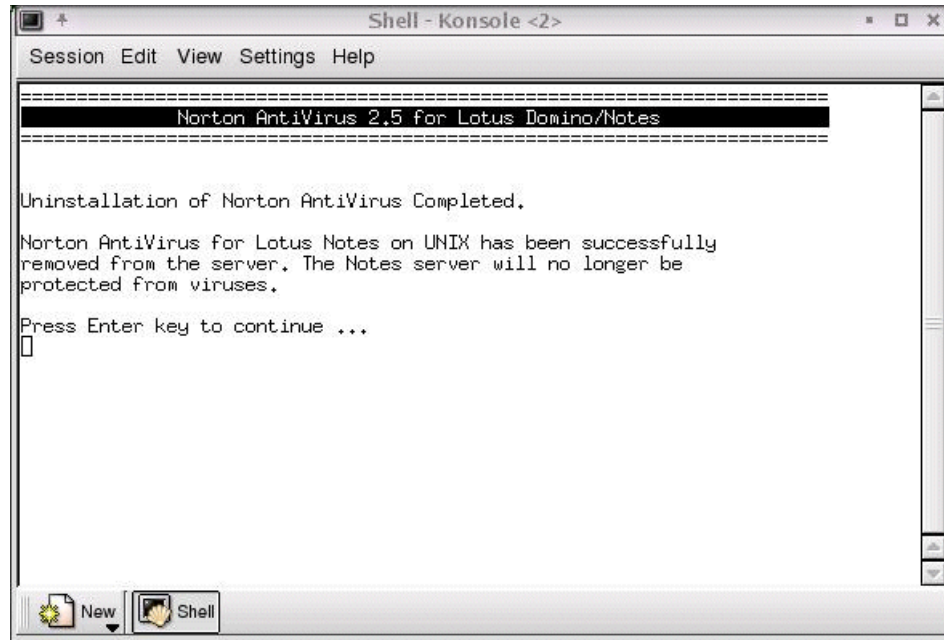


Figure 7-29 Uninstallation of Norton AntiVirus completion screen

5. After uninstalling Norton AntiVirus, log out, log in as Notes user, and start the Domino server.

## securiQ Suite

Group Technologies AG has a set of security-related products which are grouped into a suite called securiQ Suite. It is a server-based product and is available for the Linux operating system. In this section we briefly introduce the software package, highlighting some of the features that it provides.

securiQ Suite consists of the following products. Each of the modules can also be used separately:

- ▶ securiQ.Crypt  
Provides centralized, server-based e-mail encryption with PGP and S/MIME; it allows specific encryption relationships among different persons, groups, and companies.
- ▶ securiQ.Watchdog  
Protects against malicious attacks to e-mail and databases, and provides a proactive defense to disarm viruses. It works with a wide range of virus scanners and compression technologies to ensure maximum protection, even from the most sophisticated viruses such as worms and trojan horses.

- ▶ securiQ.Wall  
Scans e-mail content and databases to protect against breaches in confidentiality, spam, and junk mail, thereby ensuring compliance with corporate communication policies.
- ▶ securiQ.Xblock  
Prevent confidential graphical documents from falling into the wrong hands via e-mail. It analyses images of all possible formats in e-mail attachments based on visual characteristics and a number of highly complex criteria (form, color, text, etc.)
- ▶ securiQ.Trailer  
Provides centralized, parameter-driven e-mail signatures. It can be used, for example, to add a legal disclaimer to all outgoing e-mails.
- ▶ securiQ.Safe  
Archives selected e-mail traffic, even encrypted files, for quality assurance and to meet legal requirements for secure storage. Security is provided for reviewing and verifying of e-mail, and it allows only authorized personnel to have access to stored data.

System requirements:

- ▶ Lotus Domino 5.x and higher
- ▶ SuSE Linux 7.x and higher
- ▶ RedHat Linux 7.x and higher

For more information please visit the web page of Group Technologies at:

<http://www.group-technologies.com>

## 7.2 Backup

Today, data is becoming increasingly important for all companies. Domino manages more and more of these needs, and is not simply used for messaging. Workflow software uses Domino databases to generate enterprise activity, and the loss of one database could mean disaster. Even though Linux is a reliable platform, backing up your data is mandatory to prevent possible trouble.

This section describes general principals of backup management and strategy, and provides details about the backup tools provided by the Linux operating system. We discuss some of the considerations for backing up a Domino server and databases, and introduce some of the commercially available third-party products for backing up Domino Server for Linux.

## 7.2.1 Backup strategy

To implement a complete backup strategy, you have to follow a strict process which allows you to define backup rules. These rules can be very different from one company to another. Creating a backup strategy is not within the scope of this book, so we don't go into exhaustive detail about it here. Instead, we have made choices which may or may not be used in a real environment. We will use these choices to show you how to install and configure some backup software on a Linux platform.

We recommend that you create a company backup policy, if you do not have one already, and follow that policy; a good backup policy will save you a lot of trouble.

A typical backup is performed by using a backup server to back up all your Domino servers through your LAN or a dedicated backup network. Figure 7-30 on page 427 shows an example of backing up the Domino servers using an existing TCP/IP network.

For a smaller installation, you could attach a backup device directly into a Domino server; this would reduce the number servers needed. However, this is not necessarily an adequate solution because if you lose the server for some reason, you will lose *both* the server and the current backup.

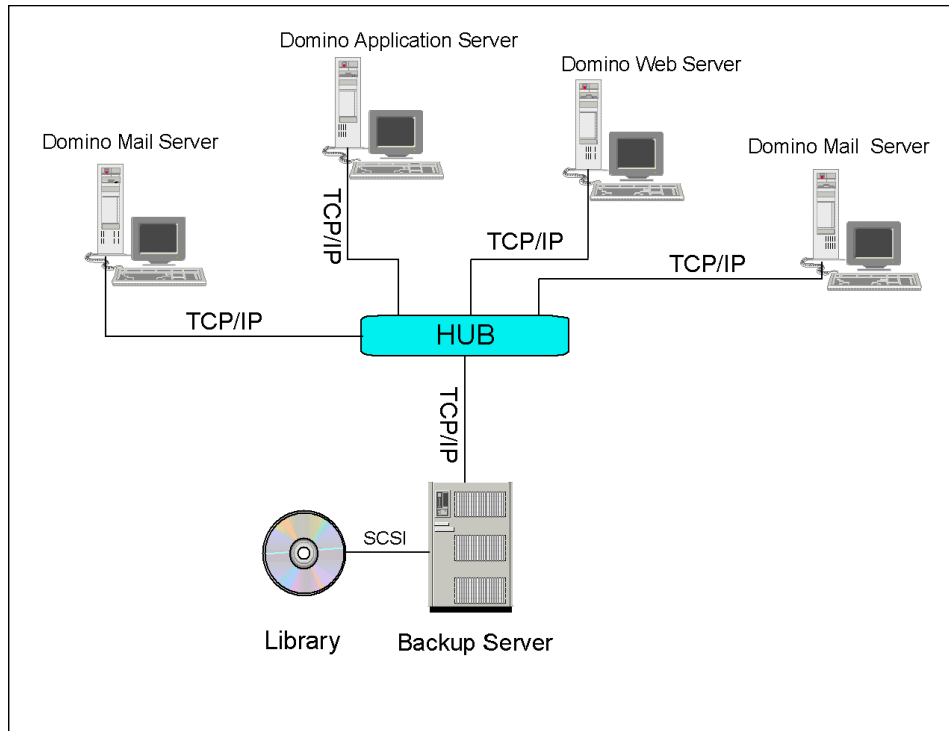


Figure 7-30 Domino backup scenario

There are two basic methods of backing up Domino: offline backup and online backup.

### Offline backup

This method is the most reliable and inexpensive type of backup procedure. The downside to this is that it cannot be done on critical systems that require non-stop operation.

To perform an offline backup, first shut down the server, back up your files, and restart the server.

### Online backup

Online backup provides a way to back up your data and still have your system in production. This option becomes more and more important with the requirement of non-stop operation. There are different options to perform an online backup. We recommend that you use a backup software product that utilizes the features provided by the backup/recovery APIs in Domino.

## 7.2.2 Backup management

In this section we discuss the management issues related to backing up files, such as why you still need backups even if you are replicating your databases, how to establish backup cycles, and how to implement incremental backups with the transaction logging enabled in Domino 6.

### Backup versus replication

Your Domino implementation may include clustering of your Domino servers so that you can replicate your databases to another system or disk. What we want to point out in this section is that replication does *not* replace the need to have reliable backups of your databases.

It is true that in the event of disk failure or disaster recovery, a replica of a database is a quick way to recover the information that was lost, but in some cases you need to recover from a previous day or week. Listed below are some cases when you would need to restore from a backup.

- ▶ Information in a database was changed, and this was discovered at a later date. Replication has already overwritten the changed information on the cluster pair.
- ▶ A database has become corrupted on the server; this was not discovered prior to that corruption replicating to the cluster or other replicas.
- ▶ An Adminp request was issued and approved to perform deletion of databases through your servers. This was discovered but could not be stopped prior to user databases being deleted.
- ▶ A user has inadvertently deleted all mail in their database and did not inform the administrator in time to stop replication.

These are just a few examples of why a reliable backup to your databases is an important part of your Domino implementation planning.

### Backup cycles

When planning for your backup, it is a good idea to develop a backup cycle that will work for your organization. You should consider the following issues when determining a good backup cycle for your office:

- ▶ Budget allocation for tapes and life cycle of tape usage
- ▶ Company policy on mail retention and archiving
- ▶ Amount of data to be backed up per server
- ▶ Time available for backup

## Domino 6 transaction logs and backups

In this section, we discuss the ways in which transaction log backups and full backups can be used to back up your Domino databases. You should review the documentation on transaction logging found in the Administration Guide to get a full understanding of the operation of transaction logs. Also see “Transaction logging” on page 229.

Domino 6, like its predecessor, provides transaction logging. With transaction logging enabled, Domino captures database changes and writes them to a transaction log. A single transaction is a series of changes made to a database on a server. An example of a transaction might include opening a new document, adding text, and saving the document. This transaction is recorded in a log file. Then, if a system or media failure occurs, you can use the transaction log and Domino aware backup systems to recover your databases.

How are the transaction logs used with backups? Let's say that in the past you made a full backup of your Domino databases once a week and then performed incremental backups throughout the week. With transaction logging enabled, you incrementally back up only the transaction logs during the week, instead of every Domino database. When you need to recover a database, you restore the database from the last full backup and then restore the transaction logs to the restored database. The Domino-aware backup system then replays every transaction that took place and so brings the database up-to-date. The backup utility you choose must use the backup and recovery methods of the Domino C API toolkit (Release 5 or later).

**Important:** You can lose data if the backup procedure is not monitored appropriately – for example, you run out of disk space or do not back up the logs before deleting them. The backup process should be monitored, especially in heavily loaded environments.

The next issue to be aware of when setting up transaction logging is the way in which the database instance IDs are created and maintained.

When you enable transaction logging, Domino assigns a database instance ID (DBIID) to each Domino database. When Domino records a transaction in the log, it includes the DBIID. During recovery, Domino uses the DBIID to match transactions to databases. Some database maintenance activities, such as compaction with options, cause Domino to assign a new DBIID to a database. From that point forward, all new transactions recorded in the log use the new DBIID. Since the previous transactions have a different DBIID, you would not be able to restore any data from the old logs. When these situations occur, you will need to perform a full backup of the affected databases.

**Important:** When the Domino server is installed, compaction of databases is performed daily by default. Change the compact task to a weekly housekeeping procedure and create a full backup of your databases after the compaction is complete.

Following are some of the cases when Domino assigns a new DBIID to the transaction logs, requiring a new full backup:

- ▶ Transaction logging is enabled for the first time or the logging style is changed.
- ▶ The compact server task is run with options.
- ▶ A fixup server task is run with the -J option.
- ▶ A Domino database is moved from one logged server to another logged server, or from an unlogged server to a logged server.

## Considerations for backup software

When you select third-party software, there are some features that relate to your Domino server that should be considered. Your evaluation of the software should determine whether it provides the following capabilities:

- ▶ Utilization of the native Domino backup/restore APIs.
- ▶ On-line full and incremental backup of Notes databases.
- ▶ Off-line full and incremental backup of Notes databases.
- ▶ On-line full and incremental restores of Notes databases.
- ▶ Off-line full and incremental restores of Notes databases.
- ▶ Selective network port addressing for backup across a LAN. This is valuable if you have installed a private network for your clustering. You can back up your servers without using the bandwidth necessary for the Domino server functions.
- ▶ Automatic discovery of new Notes databases.
- ▶ Software determines which transaction logs are aged (obsolete) and informs you or deletes logs.
- ▶ On-line recovery of entire Notes databases.
- ▶ Off-line recovery of single or multiple Notes databases.
- ▶ Automated backup scheduling for Domino server.
- ▶ Automated backup scheduling by Domino databases.
- ▶ Centralized administration of distributed Notes environment.



### 7.2.3 Hardware configuration

Since there is no Linux-specific installation, if you want to add a tape drive on a computer, follow the hardware manufacturer's instructions. All the distributions of Linux include a SCSI driver, and Linux will detect all new SCSI hardware automatically.

For each hardware device, a file in the `/dev` directory will be created. This file is used by the system to send or receive data from the hardware device. The following table shows you some sample names.

Table 7-1 Sample hardware names

Hardware peripheral	Device under Linux
SCSI, disk 1, whole disk	<code>/dev/sda</code>
SCSI, disk 3, partition 2	<code>/dev/sdc2</code>
SCSI, tape	<code>/dev/st0</code>
IDE, disk 1, whole disk	<code>/dev/hda</code>
IDE, disk 2, partition 3	<code>/dev/hdb3</code>
Generic SCSI device (some worm for ex.)	<code>/dev/sg0</code>
ATAPI CD-ROM, Secondary Master	<code>/dev/hdc</code> or <code>/dev/cdrom</code>

For the disk, Linux uses the following convention:

- ▶ The first character is **s** for a SCSI drive, or **h** for an IDE drive.
- ▶ The second character is always **d**.
- ▶ The third character represents the number of your driver converted into a letter, **a** for the first drive, **b** for the second, and so forth.
- ▶ The last character represents the partition number. You can have 16 partitions on a single drive.

The tape device begins with **st**, for a rewindable device, or **nst** for a non-rewindable device. The following number represents the tape number. It goes from 0, for the first tape drive found, to 7 for the last one.

When Linux boots, it creates a file you can read later that gives a lot of information about the machine's hardware. To see this file, connect to your server as root and type the following command:

```
dmesg | more
```

You will see all the hardware that has been detected by Linux during the boot process. Press the Space bar to go forward. On our server, the SCSI detection, hard disk drive detection, and tape detection are shown in Figure 7-31.

```

Session Edit View Settings Help

request_module[scsi_hostadapter]: Root fs not mounted
md: md driver 0.90.0 MAX_MD_DEVS=256, MD_SB_DISKS=27
md: Autodetecting RAID arrays.
md: autorun ...
md: ... autorun DONE.
NET4: Linux TCP/IP 1.0 for NET4.0
IP Protocols: ICMP, UDP, TCP, IGMP
IP: routing cache hash table of 8192 buckets, 64Kbytes
TCP: Hash tables configured (established 262144 bind 65536)
Linux IP multicast router 0.06 plus PIM-SM
NET4: Unix domain sockets 1.0/SMP for Linux NET4.0.
RAMDISK: Compressed image found at block 0
Uncompressing.....done.
Freeing initrd memory: 970k freed
VFS: Mounted root (ext2 filesystem).
scsi0 : Adaptec AIC7XXX EISA/VLB/PCI SCSI HBA DRIVER, Rev 6.2.5
        <Adaptec aic7899 Ultra160 SCSI adapter>
        aic7899: Ultra160 Wide Channel A, SCSI Id=7, 32/253 SCBs

scsi1 : Adaptec AIC7XXX EISA/VLB/PCI SCSI HBA DRIVER, Rev 6.2.5
        <Adaptec aic7899 Ultra160 SCSI adapter>
        aic7899: Ultra160 Wide Channel B, SCSI Id=7, 32/253 SCBs

blk: queue c1cf6e18, I/O limit 4095Mb (mask 0xffffffff)
        Vendor: IBM-PSG Model: DDYS-T36950M M Rev: S9HA
        Type: Direct-Access ANSI SCSI revision: 03
blk: queue c1cf6c18, I/O limit 4095Mb (mask 0xffffffff)
(scsi0:A:0): 160,000MB/s transfers (80,000MHz DT, offset 63, 16bit)
        Vendor: IBM Model: CaVv3 S2 Rev: 0
        Type: Processor ANSI SCSI revision: 02
blk: queue c27f3e18, I/O limit 4095Mb (mask 0xffffffff)
scsi0:A:0:0: Tagged Queuing enabled. Depth 253
        Vendor: ARCHIVE Model: Python 04106-XXX Rev: 727A
        Type: Sequential-Access ANSI SCSI revision: 02
blk: queue c27efe18, I/O limit 4095Mb (mask 0xffffffff)
(scsi1:A:4): 7,812MB/s transfers (7,812MHz, offset 15)
Attached scsi disk sda at scsi0, channel 0, id 0, lun 0
SCSI device sda: 71096640 512-byte hdwr sectors (36401 MB)
Partition check:
        sda: sda1 sda2 sda3 < sda5 sda6 sda7 >
Journalled Block Device driver loaded
kjournald starting. Commit interval 5 seconds
EXT3 FS 2.4-0.9.17, 10 Jan 2002 on sd(8,1), internal journal
EXT3-fs: mounted filesystem with ordered data mode.
VFS: Mounted root (ext3 filesystem) readonly.
change_root: old root has d_count=5
--More--

```

Figure 7-31 A easy way to see if the system has detected your tape drive

In the highlighted zone the Vendor is the name of the tape manufacturer and the model. The Type zone is the device type; for a tape you would see Sequential-Access. If you do not see this kind of message it is possible that Linux did not detect your tape, so you should check your hardware configuration (cable and SCSI ID).

## 7.2.4 Operating system backup tools

There are a number of utilities provided by the Linux operating system that can be used to back up a Linux server machine. This section gives you an overview of these utilities. Many of these utilities are common among the different versions of UNIX operating systems.

- ▶ **CPIO** - This utility is a UNIX system backup procedure that has been in existence since the early implementation of the UNIX operating system. Files can be backed up and restored from disk or tape.
- ▶ **TAR** - This utility is a UNIX system file archive procedure that has gained popularity on all UNIX platforms because:
  - It has built-in compression algorithms.
  - It has the possibility to create incremental backups.
- ▶ **DD** - This is very powerful tool that is used on a UNIX system to write files to disk or tape.

Tar is the most simple command to use for a backup. If you are familiar with PKZIP file compression, tar is very similar. Although it can be used to back up a networked machine, tar is most commonly used to back up a standalone server.

This command can be found on all UNIX platforms; this gives you the ability to read your backup files even on servers that are running different versions of UNIX (SCO, AIX, HP-UX, and so forth).

The **tar** command has a lot of parameters. Obtain more information about all of these parameters by typing the following:

```
man tar
```

Table 7-2 shows the most commonly used tar options.

Table 7-2 Tar options

Parameter	Action	Samples
-c	Create a new tar file	tar -c myfile1 myfile2
-f	Specify a filename for the tar file	tar -cf tarfile.tar myfile1 myfile2
-v	List the files processed	tar -cvf tarfile.tar myfile1 myfile2
-r	Append file to an existing archive	tar -rvf tarfile.tar myfile3
-x	Restore files	tar -xvf tarfile.tar
-u	Update an archive file	tar -uvf tarfile.tar myfile1 myfile2
-t	Show the content of an archive file	tar -tf tarfile.tar

**Important:** The **-c** command creates a tar archive on the default output, which is probably your screen (you can change that). If you want to do a backup into a file, add the **-f** parameter and specify a directory and a file name.

- The following command backs up all the files included in the `/local` directory onto a tape drive (`/dev/st0`):

```
tar -cvf /dev/st0 /local
```

- If you want to back up your data into a file on a disk, type the following command:

```
tar -cvf /backup/file.tar /local
```

This command will back up everything in the directory `/local` and put the archive file (`file.tar`) into the `/backup` directory.

- You can also add some new files at the end of a backup file. To do this, type the following:

```
tar -rvf /dev/st0 /newdirectory
```

This command will append to the tape the directory `/newdirectory`.

- If you want to update an archive file, type the following command:

```
tar -uvf /dev/st0 /local
```

This command will add all the new or modified files included in the `/local` directory at the end of your tape.

- It could be interesting to look at the content of an archive file. To do this, type the following command:

```
tar -tf /dev/st0
```

This shows you the tape content.

## Tar backup

The last sample shows you how to back up the data we chose in our backup strategy. As there is nothing included in tar to manage your cartridge, you will have to do that yourself.

Type the following command, and change your cartridge each day:

```
tar -cvf /dev/st0 /root /etc /home /local /opt /var
```

**Note:** The entire command must be typed on the same line.

**Important:** To back up and restore Domino data with the tar command you need to shut down the Domino server.

## Tar restore

To restore your data from an archive, log in on your system as root (you need to be able to write in the directory you want to restore) and type one of the following commands.

- If you want to restore the entire backup:

```
cd /  
tar -xvf /dev/st0
```

This command will restore all the files you have on your tape in the / directory.

- If you want to restore your data in another directory to be sure that your backup is good, type the following:

```
cd /tmp  
tar -xvf /dev/st0
```

All the data in this sample is restored in the /tmp directory.

- If you need to restore only one file from the archive, just type the following:

```
cd /  
tar -xvf /dev/st0 etc/fstab etc/ftpaccess
```

In this sample, we restore two files (fstab and ftpaccess in the /etc directory).

- Remember that you can view the archive content by typing the following:

```
tar -tf /dev/st0 > listfile.txt
```

This command will create a file called listfile.txt in the current directory that contains a description of all the files, with their full path, included on the tape.

**Important:** If you want to add some data to an archive tape, use the append command (**-r**), which will not erase the tape content. If the **create** parameter is used, the tape content will be erased by the new data.

The tar command can be used in scripts, in association with the cron table, to automate your backups.

**Note:** For the tape drive and the cartridge, the MT command allows you to do some basic operations, like *rewind* or *erase* a cartridge. Type **mt -h** (or **man mt**) to obtain this list.

## 7.2.5 Backup software from third party vendors

This section introduces some of the numerous backup software products provided by third party vendors. Many vendors offer backup software for the Linux operating system, as well as for the Domino Server. However, at the time of writing, there was only one product available for Domino Server for Linux.

### Backup software for Linux OS

Although performing a backup with backup software on a Domino Server is possible, the major drawback is that you have to shut down the Domino server for the duration of the backup. If your systems do not require non-stop operation, you could consider using one of the third-party backup products.

Among the third-party backup software solutions available for the Linux operating system are:

- ▶ IBM Tivoli Storage Manager

IBM Tivoli Storage Manager is a scalable client/server software for backing up any data. Both the server software and the client software are available for Linux platform. With the administration client you can easily retrieve and access the backed up data.

To learn more about the software and availability, check the IBM Tivoli Web site at:

<http://www.ibm.com/tivoli>

- ▶ VERITAS NetBackup BusinessServer

NetBackup 4.5 is also client/server software. Both the client and the server are available for Red Hat; only the client is available for SuSE.

Check the VERITAS Web site to learn more about the software at:

<http://www.veritas.com>

- ▶ BrightStor ARCserve Backup for Linux

CA has created backup software specifically for Linux. It has a Web browser-based user interface, there is a built-in virus scanner, and it provides disaster recovery services. The current version of the product, BrightStor ARCserve Backup for Linux 7 Advanced Edition, supports Red Hat Linux 6.x, 7.0, 7.1 and SuSE 7.2 and 7.3 according to CA's Web site at:

<http://www.ca.com>

- ▶ Galaxy iDataAgent for RedHat Linux

This is backup software for RedHat Linux from Commvault. See more information at:

<http://www.commvault.com>

## **Backup software for Domino Server for Linux**

Since most Domino servers are expected provide non-stop service, you cannot shut down the server in order to perform a backup. The only option is to perform an online backup. This is possible because Domino provides backup/recovery APIs and there are third/party products which utilize these APIs, providing the possibility to perform an online backup of a Domino server.

### ***NetWorker Module for Lotus Notes***

At the time of writing we were aware of only one backup product for Domino on Linux: NetWorker Module for Lotus for Linux, by Legato. You can find details at the Legato Web site at:

<http://www.legato.com>

At the time of writing the Legato software works only with older versions of Linux distributions and older versions of Domino for Linux. For Linux, the supported platforms are:

- ▶ RedHat 6.1, 6.2, 7.0, 7.1
- ▶ SuSE 6.4, 7.0, 7.1

Supported Domino versions are:

- ▶ Domino Server 5.04 or 5.06

NetWorker Module for Lotus Notes is installed on the Lotus Domino Server and has the ability to search out all the Notes databases on that server, using one of three user-specified search methods: the explicit filename, the standard notes directory, and a search of the whole machine. It reads the database files, formats them into a NetWorker savestream using XOpen's Backup Services API (XBSA), and passes the data to the NetWorker server. The NetWorker server may be either on the same machine, or on another machine on the network. The NetWorker Module can also be installed on the Notes Client to back up any databases that reside on that machine.

SAmong the key features provided by NetWorker are:

- ▶ On-line, non-disruptive backups
- ▶ Full or incremental backups
- ▶ Document-level backup and restore (phase2)
- ▶ Point-in-time restore and directed (to another directory) restore
- ▶ Autochanger support
- ▶ Media management (tape tracking, labeling, and bar code support)
- ▶ User notification by e-mail and log files

- ▶ Graphical scheduling interface
- ▶ Seamless integration of Notes backup with file system backup for enterprise-wide storage management
- ▶ Local or remote backup and restore
- ▶ Optional data compression and encryption

**Note:** Check the Legato Web site for newer releases.

### ***Other solutions***

There are numerous backup products from third-party vendors for Domino servers, but at the time of this writing they don't support the Linux operating system.

Some of the products are listed here; check their Web sites to see whether support has been added:

- ▶ IBM Tivoli Storage Manager for Mail (former name IBM Tivoli Data Protection for Lotus Domino)  
<http://www.ibm.com/tivoli>
- ▶ VERITAS Netbackup <http://www.veritas.com>
- ▶ CA Brightstor <http://www.ca.com>
- ▶ Commvault Galaxy for Notes R5 <http://www.commvault.com>





# A

## **Migrating from Domino for Windows to Domino for Linux**

This appendix describes how to migrate from a Domino Server on a Windows Intel platform to a Domino Server on a Linux Intel platform.

# Moving from Windows to Linux

In this scenario we assume that you are working with two physical machines, one with the current Domino server and one for the new Domino for Linux server.

## Upgrade the current server

The current Windows server should be first upgraded to the version of Domino that you will be running on the Domino for Linux server.

## Build the Linux for Domino server

Build the Domino for Linux server as described in this redbook. Add the server to the existing Domino Domain and replicate all the data from the current server.

## Move your applications from Windows NT or Windows 2000 to Linux

If your applications function today on Domino server running Windows NT or Windows 2000, they will also work on a Domino for Linux server.

Domino databases are platform independent, meaning that you can copy files from NT to UNIX and open the database without any kind of change to the file format. However, there are a few considerations to bear in mind due to the differences in the environment.

To ensure that your application will be compatible, consider the following questions before moving an application from Windows NT or Windows 2000 to Linux.

- ▶ Is your Domino application “self contained?”
- ▶ Did you use CASE (Computer Aided Software Engineering) tools?
- ▶ Does it use OS platform exploitation?

### Is your Domino application “self-contained?”

A self-contained application runs entirely inside the Domino server, without any explicit references to files, without external calls, and without importing or exporting data. An explicit reference to a file, such as `c:\domino\data\NAMES.NSF`, will not work on Linux and needs to be replaced with `/domino/data/names.nsf`. Linux does not support the backslash character for specifying paths and uses the forward slash character. Linux is case-sensitive when specifying paths and filenames, while NT is not. Case sensitivity can also be a problem anywhere an external script call, link, or hotspot is used; be sure to check that the correct case is used.

## Did you use CASE tools?

While CASE tools may be helpful, many of these tools were created with non-UNIX operating systems in mind and their output code may not be compatible with Linux. Be sure to check with the manufacturer for compatibility before using these tools.

## Does your application use OS platform exploitation?

Anything in the application that might be platform-specific could fail in the Linux environment. NT-specific services, NT Registry Sync for user registrations, Active-X controls, or compilers that rely on platform-specific libraries to compile the application will cause problems when the application is moved to Linux.

## Moving the application to the Linux server

Transferring the files from Windows NT or Windows 2000 to UNIX can be done using many methods. FTP, transfer via CDRW, Iomega Jazz drives, or other media and PCNFS are all good ways of getting the data moved over. For this example we used FTP, since it is the most common tool used in the field.

Since FTP servers are installed by default on the UNIX side and not on the NT side, it is usually easier to open an FTP session from the NT box and connect to the UNIX box. Here we are using NT 4.0.

1. From the NT box, open an MSDOS command prompt by selecting **Start -> Programs -> MSDOS**.

- a. Change directory to the server's data directory with the command:

```
cd \lotus\notes\data
```

- b. Start an FTP session with the command:

```
ftp servername
```

2. Change directory on the UNIX box to the data directory with the command:

```
cd /local/notesdata
```

3. Switch to binary transfer mode by issuing the command:

```
bin
```

4. Transfer the databases by issuing the command:

```
put names.nsf
```

or, transfer multiple files at once using wildcards with the **mput** command:

```
mput *.nsf
```

**Important:** Never add or remove databases from the OS level while the Domino server is up and running. Domino caches the data directory listing and unpredictable behavior can occur if you modify the data directory while the server is running. This could result in a server crash or hang.

## Ensuring permissions are correct

After the transfer is complete, make certain that permissions are correct on the UNIX machine. Log in to the UNIX machine and change to the data directory (cd /local/notesdata) and check the permissions on the transferred file with:

```
ls -l *.nsf
```

An example of the permissions line is:

```
-rwxrwxrwx 1 nadmsup notes 1589248 Feb 22 09:34 log.nsf
```

Interpret this record as follows:

The first column shows the permissions. The leftmost letter indicates whether this is a directory or a file. A dash (-) in the left position indicates it is a file; a directory is designated by the letter d. The next nine letters indicate the access rights to the file for the owner, group, and world, given in 3 character segments. From left to right the permissions in each segment are read access, write access, and execute access. Therefore an entry of rwx means that read, write, and execute access is granted. If any of the letters have a - in their place, then that permission is not allowed. For example, r-x means that read and execute access is given, but write access is not.

The owner is the user ID that owns the file, which is indicated by the third column in a ls -l. In this case it is "nadmsup." The owner's permissions are read from the first three permission characters in column 1 (following the file or directory indicator).

The group is identified in the fourth column. In this case it is the "notes" group. The group's permissions are identified in the next three characters in column 1.

The world is anyone else who has login access to this system. Their permissions are specified in the last three characters of column 1.

Since the Domino server is the only one that should be changing or directly reading the databases, and databases are not executable programs, the permissions for databases should be:

```
-rw----- 1 nadmsup notes 1589248 Feb 22 09:34 log.nsf
```

If the permissions are not correct you can issue the command:

```
chmod 600 filename
```

where filename is the name of the file on which you wish to change the permissions. This will give read and write access to the database for the Notes user, but will not allow anyone else to view it. Since the Domino server runs under the Notes user account and makes all of the read and write calls on behalf of the clients, most organizations will want to keep the access to the files restricted to the Notes user account.

## Checking for case sensitivity

In NT, filenames are not case sensitive, but in UNIX they are. If your scripts call for the file log.nsf and the file is listed as LOG.NSF at the OS, the file will not be found when the script runs. After the FTP completes, check to ensure that the filenames are in lowercase unless your application is specifying otherwise.

```
ls -l
-rw----- 1 nadmsup notes 1589248 Feb 22 09:34 LOG.NSF
mv LOG.NSF log.nsf
ls -l
-rw----- 1 nadmsup notes 1589248 Feb 22 09:34 log.nsf
```

**Important:** There are two modes of file transfer in FTP: binary and ASCII. Binary transfers are an exact copy and no reformatting of the file is done by FTP. ASCII transfer assumes the file you are transferring is a text file and, when transferring between platforms, will attempt to reformat the file to the native text format of the destination machine. If you are in ASCII mode when transferring a database, the database will be unreadable by Domino on the destination machine. Some versions of FTP start in ASCII mode. Therefore you should always type **bin** on the FTP command line to ensure that you are in binary mode before transferring any databases or templates.





# B

## Additional material

This redbook refers to additional material that can be downloaded from the Internet as described below.

### Locating the Web material

The Web material associated with this redbook is available in softcopy on the Internet from the IBM Redbooks Web server. Point your Web browser to:

<ftp://www.redbooks.ibm.com/redbooks/SG246835>

Alternatively, you can go to the IBM Redbooks Web site at:

[ibm.com/redbooks](http://ibm.com/redbooks)

Select the **Additional materials** and open the directory that corresponds with the redbook form number, SG246835.

## Using the Web material

The additional Web material that accompanies this redbook includes the following files:

<i>File name</i>	<i>Description</i>
<b>domino</b>	Domino 6 for Linux startup script, used during system startup
<b>startserver</b>	Domino 6 for Linux startup script, used to restart just the Domino server
<b>db2emptemplate.zip</b>	Zipped DB2 database template
<b>DB2emp.zip</b>	Zipped DB2 database, with employee data documents
<b>DB2empNODATA.zip</b>	Zipped DB2 database, empty database, with no data
<b>MySQLemp.zip</b>	Zipped database, with employee data documents for MySQL example
<b>MySQLempNTF.zip</b>	Zipped database template

## System requirements for downloading the Web material

The following system configuration is recommended:

**Hard disk space:** 10 MB minimum for the files  
**Operating System:** Red Hat 7.2 or SuSE 8.0 Linux

## How to use the Web material

Create a subdirectory (folder) on your workstation, and unzip the contents of the Web material zip file into this folder.

See “Starting Domino from a script” on page 130 for a detailed description of how to use the Domino startup scripts.

Section 5.3.4, “Creating the Domino application” on page 311 discusses the use of the DB2 employee application.



# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

## IBM Redbooks and Redpapers

For information on ordering these publications, see “How to get IBM Redbooks” on page 448.

- ▶ *Lotus Domino R5 for Sun Solaris 8*, SG24-5969
- ▶ *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968
- ▶ *Lotus Notes and Domino R5.0 Security Infrastructure Revealed*, SG24-5341
- ▶ *Backing Up Lotus Domino R5 Using Tivoli Storage Management*, SG24-5247
- ▶ *WebSphere Application Server V4 for Linux, Implementation and Deployment Guide*, REDP0405
- ▶ *Linux System Administration and Backup Tools for IBM eServer xSeries and Netfinity*, SG24-6228
- ▶ *Red Hat Linux Integration Guide for IBM eServer xSeries and Netfinity*, SG24-5853
- ▶ *SuSE Linux Integration Guide for IBM eServer xSeries and Netfinity*, SG24-5863
- ▶ *Linux on IBM Netfinity Servers: A Collection of Papers*, SG24-5994
- ▶ *TCP/IP Tutorial and Technical Overview*, GG24-3376
- ▶ *Applying the Patterns for e-business to Domino and WebSphere Scenarios*, SG24-6255

## Other resources

These publications are also relevant as further information sources:

- ▶ *LINUX in a Nutshell*, Hekman, O'Reilly & Associates, Inc., ISBN 0596000251
- ▶ *Essential System Administration*, 2nd Edition, Frish, O'Reilly & Associates, Inc., ISBN 0596003439
- ▶ *Linux Network Administrator's Guide*, 2nd Edition, Kirch - Dawson, O'Reilly & Associates, Inc., ISBN 1565924002

- ▶ *Running Linux*, 3rd Edition, Welsh et al, O'Reilly & Associates, Inc., ISBN 156592469X
- ▶ *Linux Administration Handbook*, Nemeth et al, Prentice Hall, ISBN 0130084662

## Referenced Web sites

These Web sites are also relevant as further information sources:

- ▶ IBM Linux  
<http://www.ibm.com/linux>
- ▶ Red Hat  
<http://www.redhat.com>
- ▶ SuSE  
<http://www.suse.com>
- ▶ UnitedLinux  
<http://www.unitedlinux.com>
- ▶ Linux Documentation Project  
<http://www.tldp.org>
- ▶ O'Reilly & Associates, Inc.  
<http://www.oreilly.com>
- ▶ Guardian Digital, Inc. (Linux security Web site with Linux security-related documents, articles, tools, resources)  
<http://www.linuxsecurity.com>
- ▶ CodeWeavers (the company that created CrossOver Office, which allows running Windows applications on Linux [IA32])  
<http://www.codeweavers.com>
- ▶ Wine (a Windows compatibility layer for Linux that runs on Intel-compatible machines)  
<http://www.winehq.org/>

## How to get IBM Redbooks

You can order hardcopy Redbooks, as well as view, download, or search for Redbooks at the following Web site:

[ibm.com/redbooks](http://ibm.com/redbooks)

You can also download additional materials (code samples or diskette/CD-ROM images) from that site.

## **IBM Redbooks collections**

Redbooks are also available on CD-ROMs. Click the CD-ROMs button on the Redbooks Web site for information about all the CD-ROMs offered, as well as updates and formats.



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Detailed scenarios illustrate some of the features of Domino 6 on Linux, in particular user registration, directory synchronization, creating a Domino application, and accessing external data using DB2 and MySQL. We describe how to configure Domino as a Web server, including the new security options specific to the HTTP protocol in Domino 6. Strategies and techniques for virus protection and data backups are presented, along with details about some of the third-party software packages available to help you with these management tasks.

This redbook is written for administrators with strong Domino and Windows operating system skills, but who are not experts on Linux. Therefore, we show in detail how to install and configure a Linux operating system on your server, but don't spend too much time explaining basic Domino features. Instead, we focus on demonstrating that Linux is an excellent platform on which to run Domino 6.

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